# PRINCIPLES AND PRACTICE OF CROWNING TEETH

# Principles and Practice of Crowning Teeth

A practical, systematic and modern treatise upon the requirements and technique of artificial crown work, including some incidental reference to bridgework.

WITH 459 ILLUSTRATIONS.

*By*
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TO MY FRIENDS

TRUMAN W. BROPHY, LL.D., M.D., D.D.S.

AND

RODRIGUES OTTOLENGUI, M.D.S.,

In recognition of their personal and professional attainments, and as a small evidence of appreciation of their friendship, and of gratitude for their counsel and assistance

THIS BOOK IS RESPECTFULLY INSCRIBED

BY THE AUTHOR.

# Preface.

The development of the specialty of crown and bridgework, and particularly of the methods of crowning teeth, has been so rapid that it has probably been difficult, if not indeed quite impossible, for the average practitioner to keep apace with the numerous modifications of, and improvements in, the various methods of procedure which have been constantly presented and advocated in the evolution of this specialty from a somewhat chaotic, and at best unsystematic beginning, to its present acknowledged position as a distinct and highly artistic and practical department of dental prosthesis.

It is therefore believed that there is a need at the present time for a strictly modern text and reference book, embracing a tangible, systematic and practical classification of the subject, supplemented with adequate illustrations.

In assuming to supply such a possible need an effort has been made to present the subject matter in a practical and concise form, and in a more or less systematic and sequential order; as well as to avoid, in so far as possible, any consideration of methods which may have proven, or which are deemed, to be impracticable; or those which may have been abandoned, or have become obsolete.

Special care has been given to the presentation of the various methods which are practiced, and which are recognized as possessing merit and practicability. This is deemed warrantable, and indeed essential, for the reason that in the successful practice of a specialty in which a very high order of art and mechanics is demanded, and which involves more or less permanent application as a part of the human economy, where the conditions presenting are so greatly diversified, there is no *one best* method. Some procedures will be found more applicable to one case than to another, and to be more practical and successful in some hands than in others.

Personal equation and good judgment will dictate and enter largely into, the application of the most practical method to be pursued in each case, and this will usually have as much bearing upon the success and serviceability of the operation contemplated, as will the degree of skill which may be exhibited in the execution of the details of construction.

The various methods and technique of modern procedures are presented and commented upon from an original and unbiased viewpoint. This is done with the belief that their respective application and practicability will thus probably be more logically elucidated; and that their merits will be less likely to be overestimated, than if they were presented in the language of the original advocate, because of the enthusiasm which would thus naturally tincture the claims made for them.

In so far as possible every effort has also been made to acknowledge and give due credit as to the origin of the many valuable and ingenious ideas and suggestions which have aided so much in the development of this class of work, and in placing this specialty upon a somewhat sound, systematic and practical basis; as well as to those which have served to facilitate and expedite the procedure and to relieve the patient of any unwarranted or unnecessary discomfiture incident to the operation.

Where several similar methods of detail are mentioned in connection with a single mode of procedure, they are invariably placed in the order of their preference, unless otherwise emphasized in the text.

All reference to the therapeutic, or surgical technique possibly indicated in the treatment of pathological conditions involving the roots of teeth, or surrounding tissues, has been purposely avoided, in the belief that such matter more properly belongs to works on therapeutics *per se*, rather than to a book which is designed only as a practical, and comprehensive elucidation of the principles, practice and technique of modern methods of crowning teeth.

HART J. GOSLEE.

Chicago, Ill., April 30th, 1903.

# Principles and Practice of Crowning Teeth.

## History and Development of Crown Work.

CHAPTER I.

Primitive Application of Crowns. First Application of Porcelain Crowns. The Use of English Tube-Teeth for Crowns. The Foster Crown. The Mack Crown. The Shell or Telescope Crown. The Gates-Bonwill Crown. The Howland-Perry Crown. The Richmond Crown. The Büttner Crown. The How Crown. The Weston Crown. The Logan Crown. The Brown Crown. The Webb Crown. Application of Porcelain to Crown Work. Various Modifications of These Principles.

While dental literature as early as the beginning of the eighteenth century records instances of the application of *pivot* teeth to roots, the practical introduction of artificial substitutes for the natural crowns of teeth lost through accident, or by the process of caries, and the ultimate development of crown and bridgework is purely the product of the last half of the nineteenth century, and must be placed to the credit of American dentistry.

As the profession itself has from humble environments grown and broadened into a scientific calling with marvelous rapidity, so also has the specialty of crown and bridgework, the evolution of the application and construction of which forms an interesting chapter in any history of the conception, progress and advancement of all that pertains to dental art and prosthesis.

Besides opening new fields for higher artistic conceptions, it has also materially affected the general advancement of the profession, for at one time it seemed propitious and apparently inevitable that the latter

should become divided into the separate branches of operative and mechanical dentistry, and that it would be the exception rather than the rule for the average person to attain a degree of proficiency in both branches so dissimilar to one another.

This specialty, however, then just budding into general favor by the recognition of its possibilities, and so equally dividing the labor involved between the mind and the hand, the chair and the laboratory, soon proved the fallacy of such thoughts, and resulted in reuniting these branches, thus greatly encouraging the unprecedented advance which the profession has since made.

To crown and bridgework also can be attributed much of this progress, for no field in art or mechanics offers greater opportunity for the display of individual skill and artistic attainments.

The employment of these talents in any line cultivates the finer instincts, promotes a higher sense of appreciation of nature, and draws a

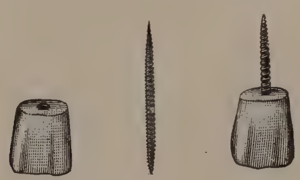

Fig. 1.

Fig. 2.

fine line of distinction between the tradesman or artisan and the true artist; and, in the province of dentistry, enables one to more nearly imitate, and often improve upon, the normal or abnormal conditions which lend so much to the appearance and comfort of those who might otherwise be prematurely disfigured or permanently subjected to discomfiture.

**Primitive Application of Crowns.**

From available records the first application of "pivot teeth" is described in Fauchard's work, published in 1728, in which mention is made of a crown fastened to the root with a pivot, and which consisted of a crown carved out of bone or ivory, or one of a natural tooth, mounted upon the root with a roughened pivot of silver or gold. The interior of the root was first filled with lead, into the center of which a hole was afterward drilled for the reception of the pivot, the other end of which had been previously cemented in a hole in the crown. Fig. 1.

**First Application of Porcelain Crowns.**

In the work of de Chemant, published in 1816, nearly one hundred years later, much reference is made to the use of "mineral paste," and a brief description is given of "a single tooth with pivot," accompanied with a crude illustration, which indicates that it was intended as a crown to be attached to a root. Fig. 2.

While other designs of "mineral" teeth were subsequently recorded in French literature, in which country porcelain was first applied, it was not until about 1840 that much effort was made toward the preservation of broken-down roots, or much thought given to the problem of restoring lost crowns of teeth, the prevailing and common practice having been to extract them and insert plates; or, in some instances, to grind them down even with the tissues and retain them for the purpose of preventing alveolar absorption.

**English Tube Teeth.**

About this time more progressive and esthetic ideas were conceived which resulted in the introduction and first practical application in this country of artificial crowns, in the form of the English tube-teeth, designed and previously used for plate work; they were ground to fit the root and mounted with pivots of hickory wood. This was conceded to be a marked step in advance—a revelation indeed—and proved

*Fig. 3.*

*Fig. 4.*

the formative period of that class of work which was destined to develop into such an important specialty. But the theory of the wooden pivot serving as a means of anchorage by virtue of the expansion incident to the absorption of moisture soon proved impracticable, because of the inadequate stability, and not infrequent occurrence of fractured roots as a result of the swelling of the wood, as well as the necessary presence of moisture which induced decay. Fig. 3.

Some modifications of this method are recorded whereby effort was made to overcome the objectionable features and permit of the removal of the crown in order to facilitate the treatment of the roots, which developed into a necessity as the result of sealing them up without proper aseptic considerations.

The most prominent of these were the crown attachment patented in 1844 by Dr. J. S. Dodge, which consisted of mounting a wooden tube into the root and attaching a metal dowel to the crown with plastics, which fitted closely into the cylinder of wood, yet rendered its removal easy; and the design of Dr. F. H. Clark, patented in 1849 and comprising the insertion of a metal tube in the root which was anchored securely with a

large-headed screw-pivot, perforated through the center to allow accumulated gases to escape. To the projecting or free end the crown was attached.

**The Foster Crown.**

Because of the tendency of these crowns to loosen in their attachment to the pivot, and the objections to wooden pivots, the Foster crown was patented in 1855, and while constructed upon almost the same lines as one designed some five years preceding it, by Dr. Henry Lawrence, it enjoyed quite an extensive use for a number of years under the former name. It possessed almost a flat base, with a perforation in the body of the porcelain so shaped as to form a seat for the accommodation of the enlarged head of a screw-pivot, by which means it was anchored securely to the root. Fig. 4.

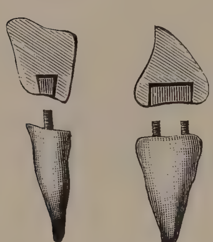

Fig. 5.

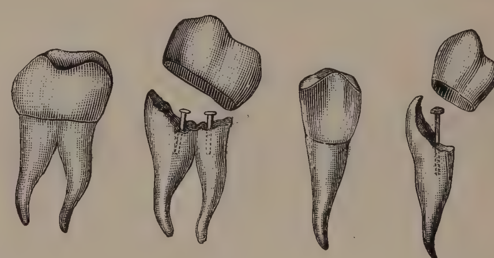

Fig. 6.

**The Mack Crown.**

While in the former styles the dowel was first attached to the crown and then subsequently to the root, the design of Dr. C. H. Mack, patented in 1872, is recorded as the first instance where the dowel was attached firmly in the root before the crown was fixed in place upon it. The crown was constructed with a countersunk cavity in the body of the porcelain which, being filled with plastics, anchored it securely when mounted. Fig. 5.

**The Shell or Telescope Crown.**

The difficulty experienced in adapting any of the former styles to the posterior teeth in a practical or permanent manner, and the desirability of restoring and preserving their normal functions, ultimately led to the invention of the gold shell or telescope crown, patented by Dr. J. B. Beers in 1873, though probably first suggested by Dr. W. N. Morrison some few years previously.

This crown proved a great step in the line of progress and development, because the construction did not require the sacrificing of tooth

structure to the extent necessary for porcelain crowns, and made possible the better and more serviceable reproduction of natural tooth forms. The seam of union between crown and root was for the first time carried under or within the free margin of the gum and apparently made the operation a more permanent success than had theretofore seemed possible. Fig. 6.

The success and practicability of this style of crown has resulted in the subsequent invention from time to time of innumerable systems and methods of construction, all of which while varying in detail accomplish practically the same end; and, while it has done much to prove the advisability of encompassing the end of the root with a band, and to a great extent made possible the ultimate success of permanent stationary bridgework, its virtues have been most grossly abused in their application to anterior teeth, and through their production in ready-made form, the use of which, in justice to the artistic possibilities within the reach of the modern dentist, cannot be too vigorously condemned.

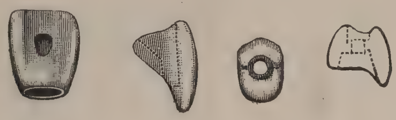

*Fig. 7.*

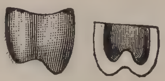

*Fig. 8.*

**The Gates-Bonwill Crown.**

As the result of the more or less successful experiment with the Foster and Mack crowns, an improvement subsequently appeared in a tooth that became known as the Gates-Bonwill crown, a patent having been issued to Dr. W. H. Gates in 1875, and to Dr. W. G. A. Bonwill in 1881, covering practically the same ideas.

This crown was of porcelain, constructed with a concave instead of a flat base, and having a triangular perforation through the body of the porcelain, afforded a better and more secure means of attachment to the root, to which it was secured by means of a metal dowel which was threaded and screwed into the canal, after which the crown was anchored with amalgam. Fig. 7.

**The Howland-Perry Crown.**

Shortly after this the Howland crown, subsequently modified by Dr. S. G. Perry, and styled the Howland-Perry crown, was suggested. This was very similar to the preceding ones, but differed, like the Mack crown, in that the accommodation for the dowel was confined to a cavity in the body of the porcelain, instead of passing entirely through it. This followed the then developing tendency toward the

esthetic, by the preservation of the continuity of the exposed surfaces of porcelain, not disclosing the end of the metal dowel or the mounting material. Fig. 8.

**The Richmond Crown.**

This design was patented by Dr. C. M. Richmond in 1880, and consisted of a cap encompassing the end of the root, to which a facing similar to the ordinary plate tooth was attached by soldering. This was the first practical application of a band to a root for anterior crowns with porcelain facings.

As originally designed, it consisted of a band, to which was soldered a floor, forming a cap. To this was then attached a facing hollowed out between the pins so as to accommodate a threaded dowel which, passing

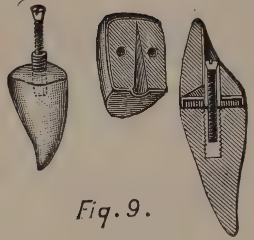

Fig. 9.

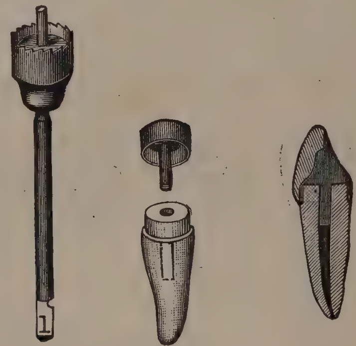

Fig. 10.

through the cap, was then screwed into a tube previously mounted in the canal, thus attaching the crown to the root. Fig. 9.

While it was then for some time a matter of doubt and conjecture as to the advisability of banding the anterior teeth, and as to whether it was an objectionable or an advantageous procedure, the original principle was soon abandoned because of the intricate and unstable manner of attachment, and the apparent uselessness of a separate dowel, but the modifications and improvements resulting from this suggestion are now conceded to be the best means of securing permanence in the operation, and are the accepted practice of today.

**The Büttner Crown.**

During the early agitation of the feasibility of banding, Dr. H. W. Büttner invented a metal and porcelain crown with a band wherein the method employed in attaching it to the root would possess the advantages of a band, and at the same time preclude its possible irritating influences.

This was accomplished by trephining the periphery of the end of the root to form suitable accommodation for the band, with instruments specially devised for the purpose, but the idea never met with universal favor, and it was soon abandoned. Fig. 10.

**The How Crown.** A crown devised by Dr. W. S. How in 1883 consisted of a thin facing with four pins and a slotted back for the reception of the "screw-post," which was anchored to the facing by bending the pins over it after it was backed up, and the desired contour was then built up with solder. The extreme thinness and consequent weakness of the porcelain rendered its usefulness limited. Fig. 11.

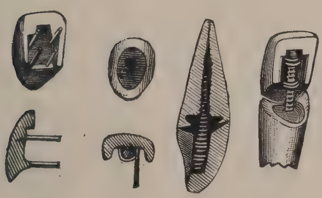

Fig. 11.

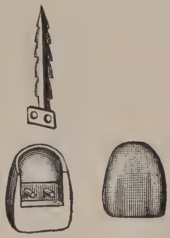

Fig. 12.

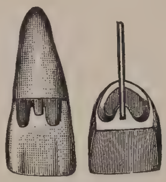

Fig. 13.

**The Weston Crown.** Another similar form was invented by Dr. Henry Weston in 1883 and subsequently modified. The first design comprised a means of attaching the dowel to the facing, which is best described by the illustration, after which it was attached to the root. Fig. 12.

In the modification the dowel was first securely fixed in the root and then the crown which was constructed with a view of being much stronger, was held in contact with the root, and anchored by packing through an opening for the purpose, on the lingual surface. Fig. 13.

It will be observed that up to this time the various steps in the development of the work consisted of a crown and dowel as two separate parts, but here a deviation in the principle was made for the purpose of securing additional strength, in which the dowel became an integral part of the crown by being baked in the body of the porcelain.

**The Logan Crown.** This crown, the first to be so constructed, was the invention of Dr. M. L. Logan, patented in 1885, and made with a large body of porcelain having a concave countersunk base to facilitate adaptation to root, and a dowel shaped more in line with scientific principles. More nearly approaching

the requirements in conformation than any of its predecessors, it soon became very popular, eventually supplanting all other designs of similar nature, and for years has had an extensive use and application. Fig. 14.

**The Brown Crown.**

Another design was shortly afterward evolved and introduced by Dr. E. Parmley Brown, and while of the same type, it possessed a base convex, instead of concave, with a view of affording by means of its construction, the greatest possible strength at the seam of union between crown and dowel, and crown and root.

Its adaptation to the root after cutting it down properly was made by using a bur which produced a concavity, to accommodate the convexity of the base of the crown; but the increased strength of the crown being secured at the expense of the root, soon resulted in its abandonment. Fig. 15.

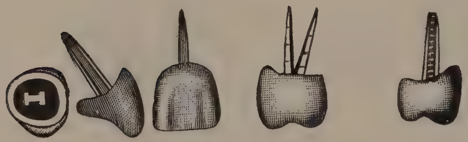

Fig. 14.

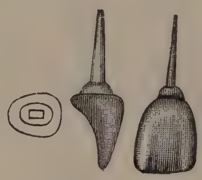

Fig. 15.

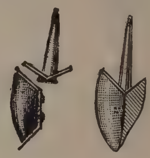

Fig. 16.

**The Webb Crown.**

The difficulty of grinding one surface to closely approximate another, and the conceded advantages of a close union between crown and root, soon stimulated a desire to secure better adaptation, and resulted in the suggestion of a plate and dowel crown probably first used by Dr. M. H. Webb.

This was constructed by swaging or burnishing a metal plate to the end of the root, then perforating it to admit of inserting into the canal a dowel, which was soldered to the plate, to which the facing was then attached. The possibilities of adaptation and its advantages have become so recognized that many still so construct their crowns, and they are frequently indicated. Fig. 16.

Soon, however, the advancement of the profession along those lines leading to the achievement of the very highest conceptions of art, indicated a tendency to observe the maxim "true art is to conceal art," and created a desire for something that might supersede the use and display of gold, something more nearly resembling and harmonizing with nature, yet, still serving the same purposes. Even in this the inventive genius of the profession was not long in again asserting itself, and soon afterward came the application of vitrified porcelain.

The first suggestions were perhaps made by Dr. C. H. Land, and were eagerly studied and enthusiastically applied with varying degrees of success and failure. Dentures of platinum and porcelain had been constructed and worn successfully for years, hence it was readily believed that crowns and bridges of the same must also of necessity be equally successful. In this, however, many were doomed to disappointment, and because of inadequate knowledge of the requirements, too much confidence, and the over-zealous enthusiasm of early advocates, its use and practicability soon became questionable, and was eventually discontinued by the great majority.

There were those, however, who, still admiring its esthetic beauties, and having faith in its possibilities, sought to ascertain the causes of failures, and the reasons for success, with the result that its more recent and modern application has approached and made possible the very highest degree of perfection in dental art and prosthesis. Yet it is not universally applicable, and will never supersede the use of gold. The success of each must always depend in a great measure upon the sound reasoning, good judgment and skilful execution and discrimination with which they are respectively applied.

It will be observed that, from the very beginning, the innate and intuitive desire for the practical and esthetic development of this work to more perfectly meet the demands and requirements of the times, has resulted in the presentation of many varied principles and methods, among which may be also included the jacket crowns; the application of porcelain facings to shell or telescope crowns; the Logan crown with the addition of a band; the various modifications of the porcelain crown with separate dowel, such as the Davis crown, the intradental band and similar designs, and a galaxy of other varying and ingenious ideas. Yet they are in the main but modifications of the original principles enumerated, and, while aiding materially in the evolution, and showing the trend of the development and progress of crown work from its inception, their individual description would be redundant and unnecessary.

Those of practical value, use and application at the present time can be treated to better advantage elsewhere than in a breif résumé of the development and history of this work, which is intended only to show the perseverance and ingenuity of our predecessors, and the various steps in making possible the success of modern crown work, for which their efforts were primarily responsible.

# Metals, Alloys and Solders.

CHAPTER II.

Symbol and Fusing Point of Metals Used. Noble and Base Metals. Chemical and Physical Properties: Chemical Action, Color, Odor and Taste, Fusibility, Malleability, Ductility, Tenacity. Physical Processes: Soldering, Welding, Annealing, Tempering, Alloying, Troy Weight. Consideration of the Metals: Gold, Karat, Platinum, Iridium. Alloys: Alloys of Gold, Coin Gold, Gold and Platinum, Platinized Gold. Solders: Platinum Solder, Gold Solders, Compounding Solders, Brass, Dorrance's Alloy, Silver Solder, German Silver, Fusible Alloys, Soft Solder, Refining Gold, Etc.

One of the first essential duties incident to the successful execution of any line of work in art or mechanics is a thorough practical knowledge of the materials used; hence, in the construction and application of crown and bridge work, wherein the use and manipulation of the metals and their combinations forms such an important feature, it is materially necessary that the dentist should be acquainted with their characteristics, physical properties and methods of manipulation.

This is imperative only that he may the better understand their application, for it no longer becomes necessary for him to be an expert metallurgist, to refine or alloy, prepare or roll his plate material, or to combine and make his solders, alloys, etc., since the manufacturers and supply houses now furnish them in all grades desired; yet a practical knowledge of the methods and detail of manipulating them serves to cultivate and make possible their more skilful application.

Of the fifty-two metallic elements known to, and so classified in chemistry, but a few of them in their metallic form are used in the me-

chanics and arts pertaining to dentistry; hence, in this connection it is only necessary to refer to or consider those the physical properties and characteristics of which are of common use and application for practical purposes, and which are contained in the following table:

| Name. | Symbol. | Fusing Point | |
|---|---|---|---|
| | | Fah. | Cent. |
| 1. Gold. | Au. | 2016 | 1102 |
| 2. Platinum. | Pt. | 3632 | 2000 |
| 3. Iridium. | Ir. | More refractory than Pt. | |
| 4. Copper. | Cu. | 1996 | 1091 |
| 5. Silver. | Ag. | 1873 | 1023 |
| 6. Zinc. | Zn. | 773 | 412 |
| 7. Lead. | Pb. | 617 | 326 |
| 8. Tin. | Sn. | 442 | 228 |
| 9. Bismuth. | Bi. | 507 | 264 |
| 10. Cadmium. | Cd. | 442 | 228 |
| 11. Antimony. | Sb. | 842 | 450 |
| 12. Aluminum. | Al. | 1292 | 700 |
| 13. Iron. | Fe. | 3000 | 1600 |
| 14. Nickel. | Ni. | 3000 | 1600 |

## Classification.

**Noble and Base Metals.**

Metallurgy divides the metals into two groups known as the *noble* and the *base*, so classified because of their affinity for and property of combining with oxygen.

The former, having less affinity, do not so readily combine with it by absorption from the atmosphere, and are more easily separated from its combination when subjected to heat; while the latter, having a greater affinity, and absorbing it more readily, are separated with much more difficulty because their compounds are not decomposed by heat alone.

| Noble Metals. | Base Metals. | |
|---|---|---|
| Gold. | Copper. | Cadmium. |
| Silver. | Tin. | Antimony. |
| Platinum. | Zinc. | Aluminum. |
| Iridium. | Lead. | Iron. |
| | Bismuth. | Nickel. |

## Chemical and Physical Properties.

While all metals possess distinct individual properties characteristic of themselves, it becomes necessary for us to consider only those of such practical importance as render them useful and applicable to our purposes.

**Chemical Action.** While all metals are more or less susceptible to the action of the secretions of the mouth, gold and platinum are the least so, and of these two platinum always withstands this influence and retains its color much better than gold, which is due mainly to the fact that platinum is commonly used in the pure state, and gold in the alloyed state.

**Color.** Each metal possesses a characteristic color, varying from the grayish-white of silver and platinum to the muddy blue of lead; and from the rich bright yellow gold to the dark red of copper; each of which is always modified more or less by alloying.

Gold and platinum, however, possess a metallic luster and colors which are in contrast more pleasing to the eye, and more in harmony with surroundings, and which are the least susceptible to change by the chemical action of the secretions.

**Odor and Taste.** Odor and taste are possessed by most metals to such an infinitesimal extent that it is almost unnecessary to mention them. Copper and zinc, however, have the most definite metallic odor and taste, but as this is apparent only when they are subjected to a temperature higher than that of the body, and they are used only for the purpose of alloying, the characteristic is of no especial importance.

**Fusibility.** All metals are capable of being reduced to a liquid state under the influence of heat, but the melting point or degree of fusibility differs greatly, and, like the color, is modified by alloying. The practical infusibility of platinum of any thickness greatly facilitates some classes of work, and the controlling at will of the fusing point of gold by alloying makes the assemblage of innumerable parts and the art of soldering a comparatively easy and simple matter.

**Malleability.** Malleability is the inherent property of a metal which admits of its being hammered or rolled into thin sheets without destroying the continuity of its surface, and permits of its easy manipulation and adaptation.

**Ductility.** Ductility is the property which admits of being drawn out into lengths of a small diameter, such as wire.

**Tenacity.** Tenacity is the property of molecular resistance to tension, upon which depends the strength of the metal.

In studying the accompanying table, it will be noted that gold, while ranking first of the five principal metals most commonly used, in malleability and ductility, ranks last in tenacity, but this, of course, refers to pure gold, the tensile strength of which is greatly increased by alloying with copper, silver or platinum.

| | | Malleability. | Ductility. | Tenacity. |
|---|---|---|---|---|
| Rank | I. | Gold. | Gold. | Iron. |
| " | II. | Silver. | Silver. | Copper. |
| " | III. | Copper. | Platinum. | Platinum. |
| " | IV. | Platinum. | Iron. | Silver. |
| " | V. | Iron. | Copper. | Gold. |

## Physical Processes.

The physical processes which mostly concern the dentist in the manipulation of the metals to accomplish the necessary and desired physical changes are those of soldering, welding, annealing, tempering, and alloying, and a clear conception of each is of infinite importance in their use.

**Soldering.** Soldering is the process of uniting surfaces of metal by fusion or superficial alloying.

**Welding.** Welding is the process of uniting surfaces of metal by molecular attraction under heat and pressure.

**Annealing.** Annealing is the process of softening or securing increased malleability, and as all metals expand under the influence of heat, they in turn become softened because of the separation of the molecules produced by this expansion.

To accomplish this, they should be slowly heated to a cherry-red and allowed to cool gradually, though plunging gold into water or alcohol does not interfere with, and the latter seems to even increase, its softness, while aluminum, fusing at a cherry-red heat, is best annealed by coating each surface with oil, then igniting same and allowing it to burn off.

**Tempering.** Tempering is the process of hardening. In gold, platinum, silver, copper, etc., it obtains as the result of manipulation and consecutive working, due to a molecular condensation; while in iron containing carbon (steel) sudden thermal changes from various degrees of heat produce hardness in

proportion to the quantity of carbon present, and the manner and method of cooling; while in some alloys the reverse condition obtains.

The accompanying table is indicative of the heat and color necessary in tempering the various kinds of instruments used. (Essig: Am Textbook, Pros. Dent., pp. 131.)

| Temperature. | Color. | Use. |
|---|---|---|
| 430 to 450 Fah. | Light yellow. | Enamel chisels. |
| 470 Fah. | Med. " | Excavators. |
| 490 Fah. | Brown " | Pluggers. |
| 510 Fah. | " purple. | Saws, etc. |
| 520 Fah. | Purple. | Wood-cutting tools. |
| 530 to 570 Fah. | Blue. | Clamps, etc., when elasticity is desired. |

**Alloying.** As alloys are a combination of two or more metals, alloying is, of course, the process of combining metals, and is of material significance because so few are now used in their pure state. Most metals enter freely into combination with others, the alloy resulting frequently possessing characteristics entirely different from those of any one of the component parts.

They always fuse lower than the highest fusing, and often lower than the most easily fusible, and in compounding them the least fusible should usually be melted first in a clean crucible, and the others added in relation to and in accordance with their fusibility, after first carefully weighing out the proper proportions.

Alloys of gold, copper and silver can be melted and incorporated almost simultaneously with comparative ease, while those containing platinum or zinc are more difficult. The former is usually added by feeding it into the molten mass in thin, ribbon or foil form, while the latter is best incorporated in the shape of brass or some other alloy of known formula, because of the rapid volatilization of the metal. When zinc is to be added in the pure state, the proper quantity should be weighed, broken into small pieces and each piece coated with a film of paraffin or wax, then quickly carried into the molten mass with pliers.

In this work it is necessary that one should be familiar with the table of weight used for the purpose.

Troy Weight.

| | |
|---|---|
| 24 grains (gr.) | = 1 pennyweight (dwt.). |
| 20 pennyweights (dwt.) | = 1 ounce (oz.). |
| 12 ounces (oz.) | = 1 pound (lb.). |

Scale.

| lb. | oz. | dwt. | gr. |
|---|---|---|---|
| 1 = | 12 = | 240 = | 5760 |
| | 1 = | 20 = | 480 |
| | | 1 = | 24 |

## Consideration of the Metals.

**Gold.** The color, malleability, compatibility, slight susceptibility to the chemical influences of the secretions, and other qualities possessed by gold make it easily the nearest approach to the ideal for universal use, and while the higher artistic and esthetic tendency should always be to avoid its conspicuous display in the mouth as much as possible, its sphere of usefulness is unlimited.

Owing to its extreme softness in the pure or unalloyed state, however, it must be combined with other metals which will impart, to a desired degree, the stiffness and strength necessary to withstand the stress and wear imposed, without appreciably affecting its other qualities, and the ease with which it may be thus alloyed greatly enhances its value.

In prosthetics the use of gold in the pure form is necessarily limited, being usually confined to work where a perfect adaptation is indicated, such as backings for porcelain facings, individual bands, etc., where it is to be afterward reinforced, and also as a solder for platinum work.

**Karat.** In alloying gold the term karat is applied to the degree of fineness, and designates the proportion of pure gold to the ratio of 24 parts. Thus 24 K. is virgin pure, while 18 K. is composed of 18 parts of gold and 6 of alloy.

**Platinum.** Platinum is rapidly acquiring an extensive sphere of usefulness in dental art, and because of its many admirable physical properties is second only to gold. Those of malleability and practical infusibility render its manipulation more or less easy, and have made possible the success of porcelain work in the various phases of its present application; and it withstands the chemical action of the secretions so much better than gold as to rank first in compatibility with the tissues, which take most kindly to it. It is also used extensively in alloying gold to which it imparts special properties.

**Iridium.** The use of iridium, the physical properties of which resemble, but are more refractory than platinum, is confined to alloying with the latter, the combination forming a tougher, harder metal, such as is indicated in post material for dowel crowns and other instances requiring more than ordinary strength.

## Alloys.

**Alloys of Gold.** For the purpose of reducing the fineness and increasing the strength of gold, copper and silver are mainly used as the alloy, usually in the proportion of two parts of copper to one of silver. The former imparts hardness and elasticity, and the latter pliability and strength, together with a preservation of the original color which copper alone would change, except where the desired fineness of the gold after alloying would not admit of sufficient proportions of same to possess the requisite strength, when platinum is added in small proportions to secure this result.

For crown and bridge work, where strength and good color should be combined and are prerequisites, the gold most generally used to the best advantage is of about 22 K. fineness, which is necessary to resist or secure immunity from the chemical action of the secretions, retain its color and luster and withstand the stress; and is used in plate varying from 28 to 30 U. S. Standard Gauge.

The following are three common formulæ used for this purpose:

| | | | | | |
|---|---|---|---|---|---|
| No. 1. | 22 K. | No. 2. | 21.6 K. | No. 3. | 21.6 K. |
| Pure gold, | 22 dwt. | Pure gold, | 90 parts. | Coin gold, | 50 parts. |
| " copper, | 1 " | " copper, | 5 " | Pure " | 45 " |
| " silver, | 18 gr. | " silver, | 5 " | " silver, | 5 " |
| Platinum, | 6 gr. | | | | |

**Coin Gold.** The United States coinage, gold, 90; copper, 10, was for many years the means of furnishing plate which was used exclusively, but which is not employed so extensively now because of the extreme hardness of gold alloyed with copper alone, and of the objectionable reddish color, which is not so pleasing to the eye, especially when contrasted by proximity with the bright yellow of a pure gold filling. It may be used to good advantage, however, in combination with pure gold and silver in proper proportions, because of the definite knowledge of the proportion of copper contained.

**Gold and Platinum.**

Gold and platinum alloy is indicated wherever additional strength and springy elasticity are desired, such as clasps, and for stiffening the work over parts which will be subjected to more than ordinary stress, which property the addition of platinum, one part in 24, imparts to the alloy. The following formula is used for the purpose:

| | |
|---|---|
| Pure gold, | 20 parts. |
| Pure copper, | 2 " |
| Pure silver, | 1 part. |
| Platinum, | 1 " |

**Platinized Gold.**

Platinized gold is a form of plate made by fusing pure gold over one surface of platinum, which upon being passed through the rollers then presents a smooth, unbroken surface of each metal. It is much used in gold work where infusibility seems desirable, and the presentation of a surface of gold preferable to that of platinum. It is also frequently useful as a backing for porcelain facings because of the advantage of controlling or preserving the color by placing next to the porcelain whichever surface may cause the least, or produce the most desirable, change.

## Solders.

**Platinum Solder.**

The advent of porcelain work and the use of high fusing "bodies" has created a demand for a solder more infusible than pure gold, which was previously used for the purpose, in order that joints so made would not be affected by the high degree of heat necessary to fuse or vitrify the body.

If there is absolute contact of the parts to be united, pure gold can be successfully used, because if thoroughly and sufficiently fused, it becomes an integral part of the platinum by alloying with it; but in extensive work platinum solders are an advantage because of overcoming the possibility of a change in the relation of the parts, caused by the shrinkage of the porcelain, which is considerable.

Such solders are now prepared for the purpose, ranging from 10 to 40 per cent of platinum in combination with gold, but less than 20 per cent is of no advantage, and more than 25 per cent is unnecessary. They may be easily compounded by thoroughly fusing the gold and then feeding into the molten mass the desired proportion of platinum in foil or ribbon form, after which it should be hammered out and remelted several times to insure a thorough admixture.

**Gold Solders.** Gold solders are alloys of gold so compounded as to fuse slightly lower than plate of the same fineness or karat; should be composed of the same metals to preserve a close resemblance in color, and differ only in the incorporation of a metal which will reduce the fusing point and impart flowing properties. Thus a 20 K. solder, for instance, should fuse readily on plate of the same K., otherwise it would not be a solder in the sense of the meaning.

Zinc is mostly used for the purpose of reducing the fusibility and imparting the requisite flowing properties, but should not be in proportion more than 1½ to 2 parts in 24; because if in greater quantity the alloy would be rendered brittle, the strength thus diminished, and the susceptibility to chemical influences when exposed to the action of the secretions increased. Solder of a lower K. than is absolutely necessary should never be used, because the lower the K., the greater the affinity for oxidation and the susceptibility to chemical action; and in consequence the seam of union and the surface exposed are always rendered more or less conspicuous; hence it is desirable to begin with as high a karat as possible, so that subsequent solderings may be made with those of a degree of fineness which will aid in precluding this tendency. And as the grades which are prepared for our use invariably run lower than the karat stamp upon them, those of so-called 16 and 14 karat have but a very limited sphere of usefulness.

The following formulæ give the average composition of the various grades of dental solders:

22 K. Solder.

| | |
|---|---|
| Pure gold, | 22 dwt. |
| Brass, | 2 " |

Coin Solder.

| | |
|---|---|
| Coin gold, | 5 dwt. |
| Brass, | 1 " |

20 K. Solder.

| | |
|---|---|
| Pure gold, | 20 dwt. |
| Dorrance's alloy, | 4 " |

18 K. Solder.

| | |
|---|---|
| Pure gold, | 18 dwt. |
| " silver, | 3 " |
| " copper, | 1 " |
| Brass, | 2 " |

16 K. Solder.

| | | |
|---|---|---|
| Pure gold, | 11 dwt., | 12 gr. |
| " silver, | 3 " | |
| " copper, | 1 " | 12 gr. |
| " zinc, | | 12 gr. |

14 K. Solder.

| | | |
|---|---|---|
| Pure gold, | 14 dwt. | |
| " silver, | 5 " | |
| " copper, | 3 " | 12 gr. |
| " zinc, | 1 " | 12 gr. |

**Compounding Solders.** As most of the scrap gold must of necessity be of uniform karat or degree of fineness for the reasons previously mentioned, and because of the ease of securing the various karats of plate and solder by the dentist, it is scarcely necessary to observe or be familiar with the method of ascertaining and computing the fineness of gold to any extent, but as it may often be desirable to compound solders it is well to know the method of reducing scrap to the various karats used.

The following simple rule will enable anyone to reduce a given quality of scrap to any desired fineness of solder.

**Rule.** Multiply the weight of gold by the karat and divide by the *desired* karat. The difference between the answer after dividing, and the original quantity of gold, is the quantity of alloy necessary to be added.

**Example.** Reduce 4 dwt., 3 gr., 22 K. gold to 18 K. solder.

4 dwt. + 3 gr. (original quantity) = gr. 99.
99 × 22 (original karat) = 2178.
2178 ÷ 18 (desired karat) = 121.
121 — 99 (dif. bet. result and orig. quantity) = 22.
Ans.: 22 gr. of alloy should be added.

For this purpose the alloy should of course contain copper, silver and zinc, and may be secured in the most convenient form in the shape of known formulæ, such as brass, Dorrance's alloy, or silver solder.

**Brass.** Brass is composed of copper and zinc in proportions suitable for the purpose intended, usually varying from equal parts of each to 70 of copper and 30 of zinc, and owing to its close resemblance to gold in physical properties and characteristics is much used in various lines of work. When used as an alloy for gold in compounding solders, its definite formula should of course be ascertained, and that composed of copper 50, zinc 50, is the best for the purpose.

**Dorrance's Alloy.** Dorrance's alloy, suggested by Dr. W. H. Dorrance, is used extensively in reducing gold to solders, being a combination of the three principal metals used, in good proportions, with copper in the preponderance. The following is the formula:

| | | |
|---|---|---|
| Copper, | 6 | parts. |
| Silver, | 2 | " |
| Zinc, | 4 | " |

**Silver Solder.** Silver solder is an alloy of copper, silver and zinc, with silver in the greatest proportion, and is much used in the making of gold solders, as the alloy, as well as being an economical hard solder for various lines of work where brass and German silver are used. A common formula is:

| | | |
|---|---|---|
| Silver, | 6 | parts. |
| Copper, | 3 | " |
| Zinc, | 1 | part. |

**German Silver.** German silver is used to some extent in temporary work of all kinds, such as dowels for temporary crowns and bands for matrices, etc. It is composed of copper and zinc, with the addition of nickel, which increases the fusing point and gives a harder, tougher alloy.

The following formula is much used:

| | | |
|---|---|---|
| Copper, | 50 | parts. |
| Zinc, | 30 | " |
| Nickel, | 20 | " |

**Fusible Alloys.** Fusible alloys are those in which the lower fusing metals are combined, such as lead, tin, bismuth, antimony, and cadmium, and are intended for use in making dies and counterdies for swaging in crown-work, and for the purpose of obtaining models direct from plaster impressions, or from the mouldine compounds suggested by Dr. George W. Mellotte, and composed of potter's clay and glycerine. The extreme fusibility of these alloys depends to a great extent upon the proportion of bismuth incorporated, and varies accordingly. The following are formulæ of the various known alloys of this nature:

Wood's Alloy.

| | |
|---|---|
| Bismuth, | 5 |
| Lead, | 4 |
| Tin, | 2 |
| Cadmium, | 1 |

Fusing point, 140° F.

Rose's Alloy.

| | |
|---|---|
| Bismuth, | 8 |
| Lead, | 8 |
| Tin, | 3 |

Fusing point, 174° F.

Newton's Alloy.

| | |
|---|---|
| Bismuth, | 8 |
| Lead, | 5 |
| Tin, | 3 |

Fusing point, 200° F.

Hodgen's Alloy.

| | |
|---|---|
| Bismuth, | 8 |
| Lead, | 5 |
| Tin, | 3 |
| Antimony, | 2 |

Fusing point, 224° F.

Mellotte's Alloy.

| | |
|---|---|
| Bismuth, | 8 |
| Tin, | 5 |
| Lead, | 3 |

Ordinary Formula.

| | |
|---|---|
| Lead, | 1 |
| Tin, | 1 |
| Bismuth, | 2 |

Fusing point, 200° F.

R. C. Brophy's Alloy.

| | |
|---|---|
| Bismuth, | 3 |
| Lead, | 2¾ |
| Tin, | 2½ |

Fusing point, 240° F.

Crouse's Alloy.

| | |
|---|---|
| Bismuth, | 8 |
| Lead, | 5 |
| Tin, | 5 |
| Cadmium, | 1 |

Fusing point, 190° F.

Molyneaux's Alloy.

| | |
|---|---|
| Lead, | 3 |
| Tin, | 2 |
| Cadmium, | 2 |
| Bismuth, | 5 |

Fusing point, 140° F.

The lower fusing of these various well-known alloys may be cast directly into plaster, gutta percha or modeling compound impressions, without waiting for them to dry out, and Dr. Grant Molyneaux recommends that such impressions should be dipped in water just before pouring with his alloy to secure the best results.

**Soft Solder.** While there is probably but a very limited use for soft solder, it may sometimes be indicated in temporary work. The ordinary tinner's solder is composed of equal parts of tin and lead, though any of the fusible alloys will answer the purpose equally as well.

**Refining Gold.** It frequently occurs that the accumulation of scrap gold in the laboratory may become so contaminated with base metals, from contact and from the file, that it could not well be used over again by melting and rolling into plate, which convenience sometimes requires, without being first subjected to some simple process of refining.

When the scrap is composed mostly of a known degree of fineness, this may be quite easily accomplished without resorting to the chemical process, by what is known as the *roasting method.*

This consists of placing the scrap in a clean crucible with plenty of borax, and applying heat until a perfect fusion is reached, when small pieces of potassium nitrate (saltpetre) should be consecutively added.

This oxidizing agent furnishes usually sufficient oxygen to oxidize all base metals, which oxides are absorbed by the borax, and if kept up long enough will result in so materially refining the gold as to permit of its being annealed, rolled to the desired thickness and used over again.

## Recovering and Refining Waste Gold.

While it is very probable that the average dentist will have neither the time, inclination nor facilities for recovering the waste gold which daily finds lodgment in, or becomes attached to, sweepings, rugs, carpets, disks, strips, etc., yet the method usually employed in obtaining and refining it may be of some general interest.

The sweepings and such various articles as may contain gold are first placed in a suitable vessel, and subjected to a degree of heat in a blast furnace which will reduce them to ashes and residue, after which this latter is then *finely powdered*.

The gold, together with its impurities, can now be separated from most of the ash, carbon, sand, etc., by a mechanical process of *washing*, in which, because of the high specific gravity of the metallic masses, the latter will seek the lowest point, allowing the residue to remain on top.

The gold may now be extracted from the remaining mixture of heavy material by the following method: Treat with nitro-hydrochloric acid (aqua regia), heat gently, agitate occasionally, and then allow the mixture to stand for a few hours.

The solution is now evaporated until all free acid has been expelled, when it is allowed to cool, and alcohol and potassium chloride are added, which precipitates any platinum that may be present.

The gold may now be precipitated from the *filtered* solution by adding ferrous sulphate, c.p., or heating it with a solution of oxalic acid, when the precipitate, a fine brown powder, should be washed with distilled water, placed in a graphite crucible and thoroughly fused with potassium nitrate (saltpetre), or borax, as previously indicated.

The molten metal may be then poured from the crucible into a previously warmed and oiled mould, when an ingot of pure gold is obtained, which may be alloyed, if desired, and rolled out to suitable thickness for use.*

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*The foregoing is intended only as the essence of dental metallurgy, tinctured with practical application in its relation to crown and bridge work. I have quoted freely from Mitchell's *Dental Chemistry*, Hodgen's *Dental Metallurgy*, and the *American Textbook of Prosthetic Dentistry*, edited by Dr. C. J. Essig, and am indebted to Dr. J. P. Buckley, of Chicago, for suggestions and assistance.

# Soldering.

CHAPTER III.

Essential Requirements: Cleanliness; Acid Bath. Flux; Borax; Method of Using, Parr's Fluxed Wax, Liquid Soldering Fluids. Apposition; Requirements and Method of Obtaining. Uniform Heat; Application and Requirements. Difficulties Encountered: "Balling Up," Shrinkage, Base Metals, Gravity, Fracturing Porcelain Facings, Soldering Block Teeth. Manipulation: Soldering Without Investment. Flame Blow-pipes. Soldering With Investment, Gold Soldering, Pure Gold Soldering, Platinum Soldering, Oxy-Hydrogen Blow-pipe, Cooling After Soldering, To Prevent Unsoldering. Sweating Process. Autogenous Soldering. Soft Soldering.

In its application to dentistry soldering has rapidly assumed the significance of an *art* of much greater importance than ever attained by those presupposed past masters—the gold and silversmiths. This is readily proven by the ease with which the process is now executed in the consecutive union of a multiplicity of parts and the building or restoration of contour, as compared with the work along similar lines confined to their province.

The ease and dexterity with which such results may now be obtained by the more skilful, however, compared with the expressions of doubt and even dread manifested by others, followed by such discouraging failures as the burning or fusing of the parts, or the fracturing of porcelain facings, leads to the very natural conclusion that in such instances the lesson has not been properly learned, and that the subject merits and demands more thoughtful consideration and study, and more persevering application than is usually accorded.

To this end the dentist cannot too closely apply himself in the effort to become sufficiently skilled as to render the procedure one of simplicity and ease, together with reducing to a minimum, or eliminating, all attending dangers of and liability to, accident, which in this, the physical

process of uniting surfaces of metal by fusion or superficial alloying, will invariably follow a comprehensive knowledge of the fundamental requirements, and a close observation of all of the essentials concomitant with success.

## Essential Requirements.

These important considerations are cleanliness, flux, apposition, and uniform heat, and unless clearly understood from a practical standpoint, the process involved, while perhaps sometimes successfully accomplished, is necessarily followed in a more or less perfunctory manner, in which case the operator becomes simply an automaton.

**Cleanliness.** The thorough removal of all oxidation and deposits of foreign nature from the surfaces to be united is highly necessary in order that the solder may become thoroughly attached or incorporated, so that the element of strength may be insured in the union. This may be secured by scraping or filing the surfaces, or by treating them with an acid solution.

**Acid Bath.** For this purpose sulphuric or hydrochloric acid, diluted with an equal proportion of water, is used, into which the parts are immersed for a few moments to dissolve and remove all foreign substances.

**Sand Bath.** Sulphuric acid is preferable, and for large work should be contained in a porcelain evaporating dish of proper dimensions, as heat materially increases its cleansing properties. The dish should then be placed in a shallow sheet iron bowl partially filled with sand and placed upon a tripod over an alcohol or Bunsen flame, by which means the parts may be boiled, if necessary. As the fumes thus given off are more or less injurious when inhaled, some provision must be made for carrying them away, which may be quite easily accomplished by attaching a hood to a gas pipe and permitting the latter to pass through a hole in the window at some accessible point (Fig. 17).

For small work a much more convenient method is to freshly mix the solution each time by *pouring into* a small quantity of acid an equal proportion of warm water, when the chemical reaction will generate heat enough to thoroughly clean the parts, after which it may be thrown out.

For metal work only, where no porcelain is used, this solution may be saved by placing it in a large-mouthed bottle and used indefinitely and effectively when cold by first heating the parts to be cleaned and then plunging them into the acid.

After removing the work from the bath, it must always be thoroughly washed in clean water to so dilute the acid as to remove all traces

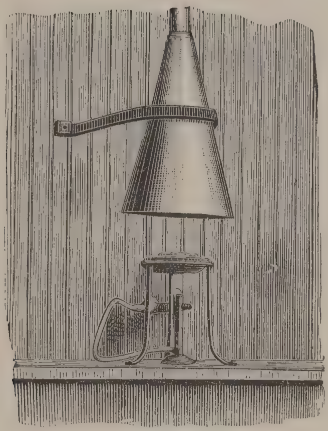


*Fig. 17.*

of it before heating in the flame, because if this is not carefully done, and any traces of acid should remain, the formation of the salts of the baser metals which is facilitated by the heat will at once preclude the possibility of soldering until again treated with acid and this precaution observed.

## Flux.

As the affinity for absorbing oxygen from the atmosphere, which nearly all metals possess, is increased by heat, the application of it incident to the process of soldering causes the exposed surfaces to become rapidly oxidized, in consequence of which it is necessary to preclude the possibility of such tendency and preserve the cleanliness of the parts in order that the solder may not be prevented from readily fusing and becoming alloyed.

Substances are used for this purpose which, when fused over such surfaces, keep them clean and free of oxidization, and aid in the fusing and alloying. It is equally necessary that the solder as well as the surfaces of metal be thus treated, because, being a lower grade alloy, it is more easily oxidized. When not so treated the neglect may not infrequently be the cause of much obstinacy in fusing, demanding a greater degree of heat than otherwise necessary.

**Borax.** Borax is most generally used for this purpose and meets the requirements in every respect, but the common practice of using it in dry powdered form, in far greater quantities than necessary, is to be most vigorously condemned, because when first heated it expands to such extent as to not infrequently split the investment and change the relation of the parts; may even flake or deface the porcelain if it should come in contact with it by fusing upon it; always displaces the solder, and usually results in the presentation of a pitted surface.

To prevent this and secure the best results, it should be mixed with clean water to the consistency of a thin paste, and applied, before heating the parts, with a small camel's hair brush, which admits of its application to the particular surfaces in the proper and necessary quantity.

Owing to the tendency to crystallize, however, it is difficult to preserve such consistency, but this may be facilitated by preparing and

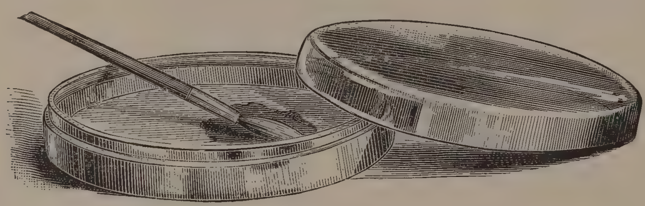


Fig. 18.

keeping it in a glass-covered dish, where it may be also kept clean and free from dirt, which is eminently desirable. (Fig. 18.)

**Parr's Fluxed Wax.** This is a hard wax, containing an admixture of borax, which is much used, and is a convenient form of flux, as the wax burns out, leaving the borax deposited upon the surfaces in small proportions.

**Liquid Soldering Fluid.** Liquid soldering fluid is now being extensively used in dentistry, and has been by jewelers for a number of years, and is the best, cleanest, most desirable and convenient flux for our purpose. It is a saturated solution of equal parts of borax and boric acid in water, and can be more easily and readily applied with a camel's hair brush or small piece of wood in proper quantity to a better advantage than any other.

In *all* instances, however, the flux should be applied before heating the object to be soldered, in order that it may be placed in or carried to every portion and surface of the metal upon which the solder should flow in securing union. This is not always possible if applied to the heated case, in which instances powdered borax is preferable.

## Apposition.

To facilitate the union between the parts, the edges or surfaces should always be in absolute contact, or as nearly so as possible, so that there may be strength in the joint, and no impediment offered to the solder in flowing freely over the surfaces to be united.

In case the proper relation necessary to be sustained will not admit of contact, it should then be secured by filling in between such edges or surfaces, thus bridging them over with small pieces of the metal of which the work is being constructed. This is usually best accomplished with gold or platinum wire or plate, or some of the foil or crystal golds, the latter being preferable because of their thickness, which should be fitted or packed into place before the case is heated.

## Uniform Heat.

The application and proper manipulation of heat in securing the best results is an important feature, but because of the under-valuation or over-estimation of the requirements is frequently the means of much discouraging and unnecessary labor, yet when properly applied with the former prerequisites observed, the entire procedure is infinitely simple.

In this connection it must be remembered that, as the process constitutes the alloying of the parts, the surfaces to be united *must be freely exposed,* and then brought to a degree of heat exceeding, or at least *equal to, the fusing point of the solder before union can obtain.*

## Difficulties Encountered.

If this degree of uniformity is not scrupulously observed, and the heat be directed upon the solder before the parts are equally and sufficiently heated to permit of alloying, the aggravating annoyance of "balling up" is invariably the result.

**"Balling Up."**

This tendency of the solder to assume globular form with more or less obstinate persistency is due only to the difference between the size of the object to be soldered and the relative degree of heat required by it, as compared with the small quantity of solder used and its consequently greater fusibility. If much time be thus consumed the baser alloy contained in the latter may be burned out, the loss or depletion of which will increase the fusibility and decrease the flowing properties to such extent, perhaps, as not infrequently to cause the melting of the parts.

As this is obvious, and since the affinity of one metal for combining with another is increased by heat, it is only necessary to first raise the temperature of the higher fusing parts equal or near to the melting point of the most fusible, when very little further heat well directed upon both simultaneously will result in perfect union with little or no effort, and as the *solder will follow the heat* or flow in the direction of the greatest degree of temperature, it can be controlled accordingly.

**Shrinkage.** As the shrinkage of solder increases in proportion to the quantity of baser alloy incorporated, and manifests itself to such an appreciable extent in gold work, it is imperative to use the utmost precautions toward preventing the possible change in the relation of the parts which might thus ensue, and which may not infrequently result in jeopardizing the fit and adaptation.

To preclude this possibility it is necessary to observe the requirements of apposition and contact very closely, and in more or less extensive work it may be further prevented by soldering each piece separately first, so that in the final assemblage of the parts as little solder may be used and carried to the fluid state as is immediately required to secure union and strength. Thus very large cases should be soldered in sections and afterward united.

**Fracturing of Porcelain Facings.** Perhaps paramount among the difficulties most frequently experienced is the checking or fracturing of porcelain facings, but this, while seemingly and apparently unavoidable, is in nearly all instances due to the most flagrant *negligence,* in so far as soldering is concerned.

In this connection it is necessary to consider the fact that a porcelain facing constitutes and presents two distinct substances, the mineral and the metal—the porcelain and the pins—each of which possesses physical properties which are affected very differently by the heat to which they are subjected.

The mineral, absorbing heat very slowly and gradually, retains it for a considerable length of time, while the metal absorbs it readily, and gives it off or cools with equal rapidity; consequently, in the process of soldering, the utmost care must be exercised in applying the heat so gradually and uniformly from the very outset that the porcelain, which is a friable material, will receive it either preceding or at least simultaneously with the platinum pins, in order that the expansion which takes place in each may occur evenly and uniformly. It is invariably this *uneven expansion,* wherein that of the porcelain is not sufficient to accommodate that of the pins, which causes the fractures occurring across the surface of the facing, always radiating from the pins. To various other reasons,

however, may sometimes be attributed this difficulty, but the percentage is very small as compared with that of uneven expansion.

Such other cases may be from *impingement* due to the shrinkage of the solder and augmented by too close proximity of parts with each other to accommodate this shrinkage; from overhanging edges of backings, which in contracting necessarily impinge upon the edges of the facings, causing innumerable small checks along such edges; to perforating the backings with openings much too large for the reception of the pins, thus permitting the solder to run in between backing and facing; or to carelessness in bending the pins (to retain the backings), in such manner as to produce a constant strain on the porcelain immediately surrounding their attachment. As a proof that it is either uneven expansion or faulty adaptation of the backing, it is noticeable that facings seldom if ever check in porcelain work where they are subjected to even a much higher degree of heat.

**Soldering Block Teeth.**

Where there has been extensive resorption of tissue it will sometimes be desirable to use what are known as gum blocks. Because of the curve of these blocks there would be more or less liability of fracture, even in skilful hands were a single backing to be used for the whole block. By a very simple method, however, blocks of three and even four or more teeth may be safely utilized, thus avoiding the unsightliness and uncleanliness of joints which would result from using single gum teeth. This absence of joints is especially desirable when restoring the anterior upper teeth, and in replacing the four incisors a most artistic result may often be attained with a single gum block. In using these blocks each tooth in the block should be backed separately, the backings being so placed that they would not absolutely touch. In adapting the blocks to the piece to which they are to be attached, care should be employed to so fit them that the minimum of solder will be required to effect union. There will be no danger of cracking the block during this last procedure, because the base to which attachment is made should afford ample resistance to the slight shrinkage of the solder at the bases of the separate backings.

**Base Metals.**

Another not unusual occurrence during the process of soldering is the appearance of small holes or perforations on the surface of the metal. These are usually due to the presence of some of the baser metals, which may become attached by contact with the dies in swaging; from a file containing same, or from the work bench, and can only be avoided by always carefully treating the piece to an acid bath immediately *preceding* each application of heat.

**Gravity.** In extensive work it is always desirable to observe the laws of gravity as much as possible, for while it is true that the solder will follow the heat, and its flowing may be so controlled in a measure, when used in considerable proportion its weight will naturally cause it to seek the lowest point; hence it frequently becomes necessary, especially in large cases for the anterior part of the mouth, where the curvature is greater, to change the position of the case as the soldering progresses in order to retain the mass in the desired location when in the fluid state.

## Manipulation.

Closely following a consideration of the requirements and difficulties encountered in this work is the importance of practical manipulation in its various phases, the proper execution of which renders the procedure easy and simple.

**Soldering Without Investment.** In soldering bands, caps, and cusps, where no investment is necessary to sustain the relation of the parts, the work is more easily accomplished because of the greater opportunities for securing uniformity of heat, and can usually be done in the flame of an alcohol lamp or Bunsen burner with ease; but the manner of holding the object in the flame, and the material of which the instruments for the purpose are made bear materially upon the dexterity and simplicity with which the procedure may be accomplished.

**Flame.** As different parts of the flame vary in the degree of intensity of heat, it is of importance that the object be held in a proper relation to the same in order that the soldering may be more easily accomplished. The flame consists of an outer sheath varying in color from a dark blue at the base to a yellowish white at the point, which envelops a central cone of light bluish color, at the summit of which the greatest degree of heat is present (Fig. 19).

Fine-pointed pliers should invariably be used and the object should be held at a point as remote from the surface to be soldered as possible, so that the pliers will not absorb the heat. Because of this tendency, steel instruments should seldom be used, while those made of nickel, or its alloy, or of steel with fine platinum points answer the purpose much better because they absorb so little heat that they may be held comfortably in the hand.

In soldering platinum with pure gold the use of flux is not imperative, for the reason that both metals are pure and devoid of alloy, which

greatly diminishes their susceptibility to oxidation, and the ordinary mouth blowpipe (Fig. 20) is all that is necessary; while platinum solder up to twenty-five per cent. can be successfully used with the "combination" blowpipe and bellows (or compressed air) (Fig. 21), or may be

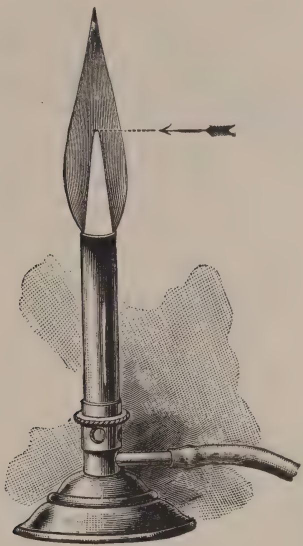


Fig. 19.

equally well done with the gasoline blowpipe, a successful and convenient style of which includes a burner and is manufactured by Dr. R. C. Brophy, of Chicago, Ill. (Fig. 22), or small pieces of platinum work where the contact and relation can be sustained by proper adjustment, and where

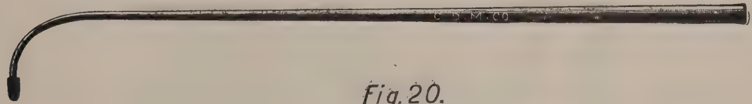


Fig. 20.

no investment is necessary, can very often be soldered in the electric furnace with much convenience.

**Soldering With Investment.**

Where the case is necessarily invested the process is usually considered as a somewhat more difficult and arduous task, which for very good reasons it unfortunately often proves to be, the principal one of which is a failure to properly and adequately heat the entire case *before attempting to solder.*

It should first always be placed upon a Bunsen or gasoline burner and allowed to remain sufficiently long to become gradually and thoroughly heated, which may be hastened, if necessary, by applying and di-

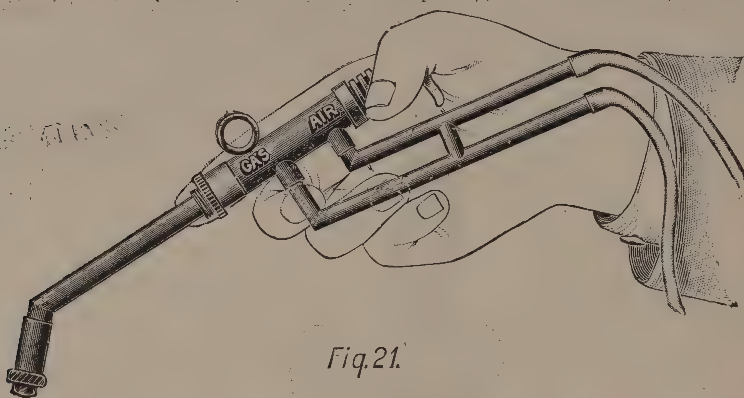



Fig. 21.

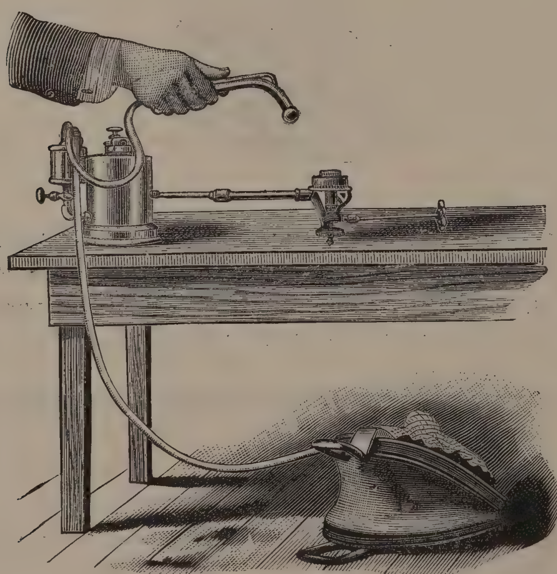


Fig. 22.

recting the heat with the "brush" flame from the blowpipe, to the under surface in conjunction with the burner. Then, when it shall have reached a temperature indicated by a red heat, the solder should be consecutively

applied in *fairly good sized pieces,* which, with the burner from beneath to preserve a uniform heat, and a "pointed" flame from the blowpipe directed upon the parts, will easily and quickly accomplish the object sought without useless expenditure of effort or energy.

The fusing and flowing of the solder in the desired location and direction may occasionally be facilitated by the use of a fine pointed steel instrument when in the partially fused or plastic state, after which only heat sufficient to solidify the mass until a smooth surface obtains should be applied.

**Gold Soldering.**

In fusing gold solder of any grade the requirements in the degree of heat so far as the blowpipe itself is concerned are generally greatly overestimated. If the case is first properly heated, the combination blowpipe controlled by the mouth easily furnishes all that is necessary, and is preferable and safer, as the danger attending the burning of the parts is always increased by the use of the bellows, because the control is not so perfect.

To blow a continuous flame with the mouth blowpipe is a valuable accomplishment and can be acquired with practice by nearly any one.

**Pure Gold Soldering.**

In platinum work, where the danger of burning is eliminated, and the requirements of heat are increased by the use of pure gold as solder, the bellows will, of course, be found convenient and useful, though even then the skilful manipulation of the mouth blowpipe will accomplish the work. However it may be obtained, heat enough to *thoroughly fuse the gold until it becomes alloyed with the platinum,* so as to occupy no apparent space except that in the immediate joint, is absolutely essential to successful results in this work.

**Platinum Soldering.**

In small cases where a large investment is not indicated, platinum solders up to twenty-five per cent. may be fused with the bellows or compressed air, but the necessary degree of heat to thoroughly and easily fuse them can, of course, be best obtained from the oxy-hydrogen flame, which is indicated always in extensive work.

**Oxy-Hydrogen Blowpipe.**

The use of an oxy-hydrogen blowpipe is regarded by many as being somewhat complex and expensive, but is in reality most simple and comparatively inexpensive. In manipulating one the illuminating gas should be turned on first and ignited, and then the nitrous oxide valve opened very slowly and gradually, until perfect combustion is obtained. The case should be first thoroughly heated with the *brush* part of the flame, after which it is necessary to bring the point of the central *cone* in

contact with the surfaces to be united, as this is the heat-producing portion. The soldering may then be accomplished with ease.

The extreme heat and incandescence, however, is very trying to the eyes, and a pair of smoked glasses will be found most conducive to success and comfort. Fig. 23 illustrates a simple and inexpensive apparatus for this work, manufactured by L. J. Mason & Co., of Chicago, Illinois.

**Cooling After Soldering.**

When the soldering has been completed, the case should remain over the flame for a few moments to prevent too rapid cooling and the consequent sudden contraction or shrinkage, after which the flame may be turned off and the case allowed to stand until cool enough

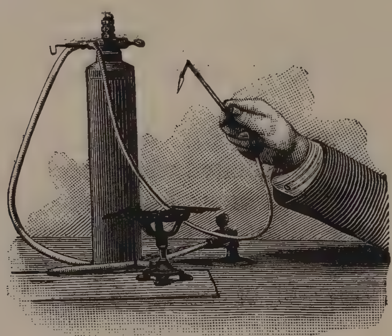


Fig. 23.

to handle, when it may be then removed from the investment, cleaned in acid, and finished.

**To Prevent Unsoldering.**

In cases where an investment is not indicated it is frequently desirable to observe some precautions to avoid the unsoldering or re-fusing of parts previously united, which is usually accomplished by the mere presence of the investment itself when such is used. This may always be very easily prevented by coating or treating such surfaces with crocus (ferric hydrate), or a liquid solution of whiting, or plumbago, in water or alcohol.

**Sweating Process.**

The not infrequent occurrence or presence of small perforations in the surface of the work makes it often necessary to resort to some means of filling them in. This is best accomplished usually by what is known as the sweating process, which simply implies bridging them over with solder.

This may apply to cases requiring investment or not, and the pro-

cedure in either instance indicated is to first thoroughly clean the parts and then fit or burnish into the opening a piece of pure gold plate or foil of suitable dimensions, which may be held in place by holding the work in a favorable position to sustain it, or attaching it by the fusion of the flux. A piece of solder somewhat larger than the perforation should then be placed in position, covering same, and likewise held in place, and then heat uniformly applied until the solder becomes firmly attached without complete fusion. In small perforations solder alone will accomplish this end, without the use of a support of pure gold or other metal.

**Autogenous Soldering.** Autogenous soldering is the process of uniting surfaces by immediate inter-fusion, without the use of a lower grade alloy, and while it has no decided advantages, excepting that a joint so made is not increased in stiffness or thickness, and the appearance of a seam of solder is avoided, it is quite easily accomplished in uniting bands and attaching solid cusps to them, in the execution of which the surfaces must be *perfectly* approximated, retained closely in contact, properly fluxed, and held in the flame until union is accomplished by superficial fusion. By a little practice one may become quite skilful, and joints so made usually possess every element of strength.

**Soft Soldering.** While soft soldering is not to be generally commended, it is sometimes indicated in emergency cases, where some strength in the union of the parts is required, as in temporary crowns, etc. For such purposes a solder composed of equal parts of tin and lead, or any of the fusible alloys, may be used, either with a soldering iron or by placing them upon an asbestos pad and directing the flame of the burner upon them until the solder fuses. A convenient flux for this work is made by gradually adding pure zinc to hydrochloric acid until the chemical action subsides or the acid refuses to take up more, thus making a solution of zinc chloride, when it may be filtered and is ready for use.

# Investing and Investment Materials.

## CHAPTER IV.

Object of Investing. Requirements of Material. Materials Used. Physical Properties. Models. Requirements of an Investment. Preparing Case for Investment. Hard Wax. Adhesive Wax. Investing. Small Cases. Extensive Cases. Precautions. Removing Wax. Preparation of Investment. Drying and Heating. Prepared Compounds.

One of the most important features to be observed in connection with the process of soldering is the proper investment of the case, the object of which is to sustain the relation of the parts and preserve a uniformity of temperature during and succeeding the application of heat.

**Object of Investing.**

By investing the parts the uneven or too rapid heating or cooling of porcelain facings and the consequent attending dangers are obviated, and any possible change in the individual relation of the parts while being united or assembled is entirely overcome.

**Requirements of Material.**

A suitable compound for such purposes should possess the essential properties of crystallization, infusibility, free conductivity and strength, and should neither shrink nor expand appreciably during the heating process.

**Materials Used.**

Many substances may be used in combination with plaster of paris, which is necessarily the basis because of imparting the property of crystallization, and which must be incorporated to the extent of at least 50 per cent.

The remaining proportion may be then composed of such materials as will, by virtue of their characteristics and physical properties, meet such requirements. The following are serviceable:

| | |
|---|---|
| Powdered Silex, | Pulverized Pipe Clay, |
| Fine Asbestos, | Powdered Fire Brick, |
| Beach Sand, | Magnesium Sulphate, |
| Marble Dust, | Pumice Stone. |

A combination of any of these ingredients in varying proportions with the proper quantity of plaster will usually possess the necessary qualities, excepting pumice stone, which, because of its low fusibility and inherent tendency to expand, should never be used, and asbestos in large proportions, which, while serving to hold the mass together, when mixed, is objectionable because of its extreme low conductivity.

**Physical Properties.** The property of free conductivity is important because this materially lessens the time consumed in heating the case, by absorbing and distributing the heat more rapidly and evenly, and by thus retaining it the better the soldering is facilitated, and the liability of checking porcelain facings diminished.

A tendency on the part of any compound to expand and crack open when subjected to the influence of heat usually indicates that the texture is too fine to admit of the rapid evaporation of the moisture, and as possible displacement of the parts and checking of facings is thereby promoted, the use of such material is objectionable and unsafe.

By the addition of a coarser ingredient to the compound, however, this fault may be overcome, and a small quantity of fine shredded asbestos will also frequently eliminate the objection in a measure, without greatly reducing the property of conducting heat.

**Models.** While, generally speaking, all models should be made of plaster alone, because of thus possessing greater strength, smoother surfaces and more accurate and definite outlines, while offering no impediment to successful soldering when properly prepared, there may be frequent indications for making them of investment material.

In such instances a material which will shrink or expand appreciably is decidedly objectionable, and the characteristics of that used for such purposes must be of known quantity, for the reason that a degree of inaccuracy in the relation of the parts and their proper adaptation may result.

Where such a model seems indicated and desirable, and especially for the purpose of the final assemblage of the parts in extensive cases, a

smooth, well-defined surface may be secured by first pouring a small quantity of thin, well-mixed plaster into the impression, then inverting the cup until all surplus runs out, leaving only a thin surface coating, when by being immediately filled with the investment material, a model is obtained possessing a veneer of plaster.

**Requirements of an Investment.**

As the object of investing is to hold the parts in their proper relation and afford protection to the facings, it is but necessary that the investment should be *only large enough* to accomplish this end.

Any surplus in excess of merely meeting such a requirement increases

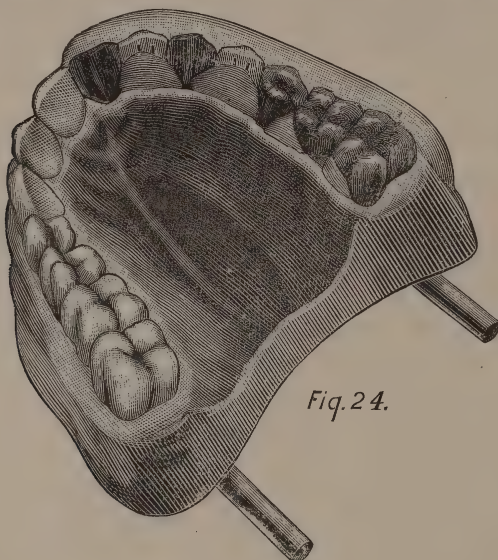


Fig. 24.

the heat necessary and adds to the labor involved in the process of soldering, without any possible advantage.

**Preparing Case for Investment.**

In assembling the individual parts on the model, some means should be observed which will temporarily sustain their accurate relation until they are safely transferred to the investment. In this particular it is necessary that they should be so securely united as to prevent any possible displacement during the process of removing from the model, and the subsequent imbedding into the investment material, with a substance sufficiently tough and strong to withstand such procedure.

This is usually accomplished by using a hard or adhesive wax as a medium of cementation, which in large cases may be further supplemented by covering the facings and crowns from the buccal or labial

surfaces with a thin layer of plaster or investment compound previous to removing from the articulator. (Fig. 24.)

In interrupted bridges or where some adaptation of bars or rests to a proper relation with the natural teeth is indicated, it may often be done to better advantage after the case is invested than when on the model. In such instances by extending or continuing the wax over these teeth so as to secure an impression of them before detaching and investing, their accurate reproduction may be secured in the investment.

**Hard Wax.** For the purpose of thus securely cementing the parts a hard wax composed of from two to four parts of resin and one of wax is reliable and much used. The combination forms a stiff, brittle substance, which for convenience should be rolled out into sticks of suitable size and length. These may be kept indefinitely by coating the surfaces with whiting or plaster to keep them from adhering to each other. Parr's fluxed wax may also be used for the purpose.

**Adhesive Wax.** As the extreme brittleness of *hard* wax is sometimes objectionable, a less brittle and more adhesive compound may often be found preferable. The following formula gives an adhesive wax possessing excellent qualities: White bee's wax, 8 oz.; pulverized white resin, 1½ oz.; gum dammar, 1½ oz. Melt in order named.

**Investing.** When the various parts are securely and firmly united, the wax should then be carried over a considerable surface of the abutment crowns and caps, including every portion of the work not to be subsequently covered by investment material. This procedure serves to keep such surfaces clean and free of dirt, and leaves them fully exposed in the investment, by guiding the flowing of same over only those parts which should be protected.

**Small Cases.** In all cases, ranging from a single crown up to four or five teeth, the abutment crowns and caps should be detached from the model, previous to cementing the parts, in such manner as to preserve their definite outline and relation. Upon being again replaced in their proper position all of the individual parts may be assembled and cemented together, when the whole can then be easily removed and invested. This eliminates the destruction and investing of the model and preserves it for future use in case of desire or necessity.

**Extensive Cases.** In larger cases, however, it is not usually good policy to follow this procedure, because of the increased liability of an inaccurate replacement of the abutment caps and crowns, especially if there be more than two. In such instances it is always safest and best after assembling and cementing the

parts firmly to first remove the model from the articulator, and then trim away all surplus plaster until only enough remains to sustain the relation. (Fig. 25.) This, then, precludes the possibility of any disarrangement or displacement of the parts, and the remaining plaster is of no significance if entirely submerged and completely covered with the investment material.

**Precautions.** The investment compound should be mixed of a moderately thin and plastic consistency, so that when the proper quantity is poured upon a piece of paper it will offer no resistance in pressing the case down into place, until it is properly submerged and sufficiently covered. If too stiff there would be danger of a change in the relation of the parts.

To make sure of a close adaptation of the material to the facings and other parts, and to hold them securely when invested, all surplus wax and dirt should be carefully removed and the case dipped in water just previous to bringing it in contact with the investment material.

Fig. 25.

The *interior* of all crowns and caps unless previously *well filled* with plaster should then be first thoroughly packed with the investment material by using a small piece of wood or fine-pointed spatula; because if not perfectly filled the presence of air spaces, into which the heat becomes concentrated during the process of soldering, will materially increase the liability of burning or fusing the parts, an accident which for this reason not infrequently occurs.

**Removing Wax.** After the investment has become thoroughly hardened and the surplus trimmed away, the wax should be slightly warmed by passing over the flame and removed as well as possible with a small knife-blade or other pointed instrument, being careful not to loosen or dislodge the parts in so doing.

Hot water may be then poured upon it, but the case should never be *boiled*, for the reason that such procedure disintegrates the compound, interferes with its perfect crystallization, and requires more time in drying out and heating up than would otherwise be necessary.

Choloroform, being a solvent of wax, is also used to remove remaining particles, but this is entirely unnecessary, because the wax will be absorbed by the investment and ultimately burned out entirely during the heating process.

**Preparation of Investment.** As soon as the wax has been sufficiently removed, the investment should be trimmed down until no larger than is absolutely required, thus leaving all surfaces upon which the solder is to become attached *freely exposed,* so as to offer no impediment to the heating of the case. No danger will accrue from this free exposure of the

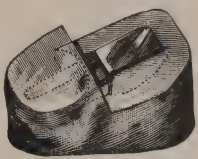


Fig. 26.

parts if the porcelain facings are covered and the interior of crowns and caps well filled, and the labor involved in the process of soldering will be materially lessened.

The investment for a single crown should be cut away from the approximal sides on a line with the backing and cap. (Fig. 26.) Where this is not observed and the investment remains banked up on these sides,

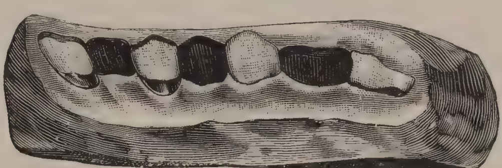


Fig. 27.

the crown is imbedded into a depression, and the soldering is made much more difficult because the flame and heat from the blow-pipe is thus deflected from the parts.

This applies as well to more extensive work, and should always be closely observed. The proper exposure of the metal parts and the necessary trimming away of the investment for larger cases is illustrated in Fig. 27.

**Drying and Heating.** When the preparation has been completed and all particles of debris removed, the parts should then be fluxed, and the case placed upon the burner until it gradually becomes sufficiently heated to proceed with the soldering.

Many devices are provided for holding the case in the flame, but the simplest, most useful and economical method is to put it upon a piece of the ordinary metal lathing used in plastering, which is made of iron and is more or less durable, and then place this upon the spider over the flame. (Fig. 28.)

**Prepared Compounds.** Several preparations possessing the required qualities to a greater or less extent can be easily procured, among which may be included Dr. R. C.

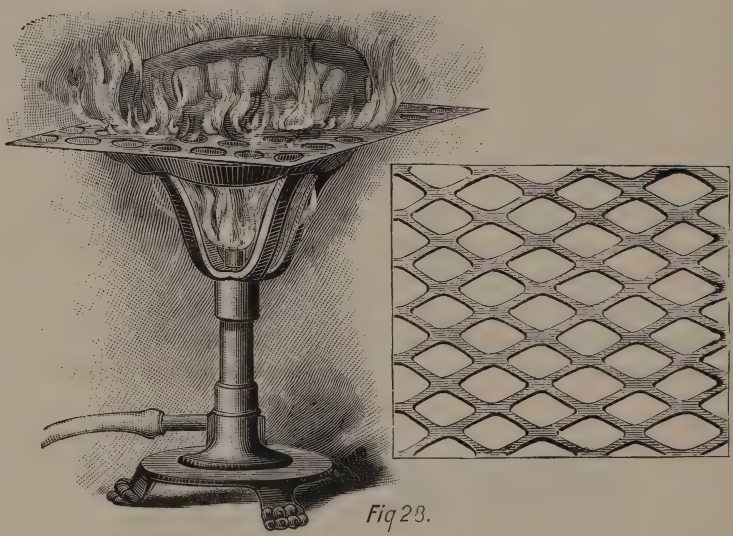


Fig 28.

Brophy's "Imperial Investment Material," the investment compound made by the Consolidated Dental Manufacturing Company; "Sump," prepared by the S. S. White Dental Manufacturing Company, and "Teague's Compound," all of which are of special merit and can be highly recommended.

# Requirements and Technique of Crown Construction.

# Indications and Requirements.

CHAPTER V.

Indications: Extensive Caries. Accidental Causes. Discoloration. Malformation. Malposition. Requirements: Physiological Relations. Anatomical Relations. Stress. Articulation and Occlusion. Approximal Contact. Mechanical Relations. Method of Attachment. Dowels. Telescoping. Fit. Strength. Esthetic Relations.

Before one is properly prepared to consider the manipulative procedure incident to the detail of construction of artificial crowns, a clear conception and a thorough understanding of the indications for, and requirements of such substitutes for the natural crowns of teeth as are generally applicable today are essentially necessary.

It does not matter particularly in what line of art or mechanics one confines his efforts, to meet with success in the direction chosen requires, first of all, the necessity of formulating in the mind, or picturing in the mental eye, the result of the contemplated effort in the finished state, before even commencing the detail of its construction.

To thus conceive the possible result before the execution, in a work where art and mechanics are so closely related to nature, greatly enhances the possibilities by cultivating the possession of those lucid and perceptive ideas which are so essential to success if success is dependent upon the attainment of special skill, as it should be.

And yet while dentistry offers no greater opportunities for the acquirement and display of the highest artistic talent than in the field of crown-work, such prerequisites alone will not always insure success, but must be supplemented by a degree of accuracy, facility and delicacy in instrumentation which will at once inspire the confidence of the patient.

Thus will he be the better qualified to obtain results more accurately restoring the normal functions and more closely approaching a reproduction of nature; and to perform them for the most nervous, sensitive patients with more gratifying success to all concerned.

In this field, as in many others, those methods which are *quickest* and *best* are not necessarily synonymous, and so it often becomes a matter of judgment and discrimination as to the employment of the particular method most applicable to the case at hand, in which the operator must be governed only by the most scrupulous and conscientious efforts.

While there may frequently be several methods of procedure that, at the first conclusion, seem apparently applicable, there is usually one in particular which upon closer observation will best meet all of the requirements.

## Indications.

The employment of artificial crowns is indicated in extensive loss of tooth structure from the ravages of caries, or accidental causes, and not infrequently because of discoloration, malformation and malposition, as a means of substitution for the correction and restoration of impaired function, and relief from disfigurement. There should always be enough tooth structure remaining, however, to insure sufficient anchorage.

**Extensive Caries.** By far the most general indication is in those instances where the natural tooth structure has suffered such irreparable loss from the process of caries as to make restoration by filling, with any assurance of permanency in the operation, either inadvisable or impossible.

In those cases, however, where it seems a matter of conjecture as to the advisability of filling or crowning, unless for esthetic reasons, the preference should be given to filling, if such procedure may seem to offer any certainty of a reasonable degree of success and permanency.

In frequent instances the remaining walls of badly broken down teeth may be protected and usefulness restored for many years by the insertion of a post into the canal, and the building of a filling around it, and such a course is often indicated for the reason that the crowning operation may then be deferred and become a subsequent and possibly remote necessity, which would perhaps add to the aggregate longevity of the root.

Moreover, the presence of a well-adapted filling is no doubt more conducive to the preservation of the normal condition of the surrounding tissues, than the most skilfully adapted crown.

**Accidental Causes.** The loss of a portion or all of the natural tooth crown in the anterior region, as the result of a fall or blow, or from overstrained masticatory action upon hard substances in the posterior region, is by no means uncommon, and usually calls for immediate relief in their reproduction and restoration.

**Discoloration.** The presence of a badly discolored tooth in the anterior part of the mouth, which persistently refuses to succumb to repeated efforts at bleaching, may

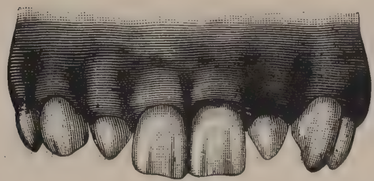


Fig. 29.

often indicate an artificial substitute as the only means of effectually and permanently remedying its conspicuous and objectionable appearance.

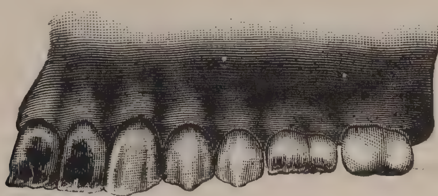


Fig. 30.

**Malformation.** In such conditions of faulty enamel formation as the so-called "peg" laterals (Fig. 29) and the pitted enamel structure, as is frequently found to exist in the first permanent molars and the anterior teeth (Fig. 30), the

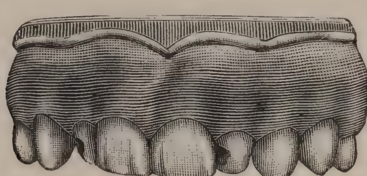


Fig. 31.

application of an artificial crown may often be indicated as the best means of restoring usefulness and affording relief from disfigurement.

**Malposition.** There are frequent instances of simple irregularity of the anterior teeth, where the age of the patient, together with the presence of caries or other

conditions may not seem to warrant their correction by the process of regulating. Often the desired effect may be obtained by sacrificing the natural crowns and substituting artificial ones as the most simple and artistic means of correcting the deformity. (Fig. 31.)

## Requirements.

The success of crown-work in the various phases of its application, and the degree of permanence in the operation, combined with the esthetic results obtained, depends upon a close observation of the requirements from a physiological, anatomical, mechanical and esthetic standpoint.

**Physiological Relations.**

When it has been determined that a crown is indicated or seems to be the most advisable procedure, it is first necessary to ascertain the condition of vitality of the immediate and surrounding tissues.

If pathological conditions exist, every effort should be made to locate and remove the cause, and the usual remedial or medicinal agencies should be applied until the tooth or root assumes as healthy and normal a condition as possible before proceeding further with the operation.

This particularly includes the *thorough disinfection* of the remaining tooth structure, and the removal of all that may prove irritating to the peridental membrane. The precaution is necessary because the presence of an artificial crown should not afford any more reason or opportunity for the deleterious action of disease-producing agencies than when the tooth was in a normal healthy condition; indeed, it should even further fortify it against attack.

**Anatomical Relations.**

In regard to anatomical relations we are governed by the position of the root and the artificial crown supported by it in their relation to the adjacent and antagonizing teeth, which includes the consideration of stress, occlusion and approximal contact.

**Stress.**

The roots of teeth carrying crowns are subjected to the influence of stress in different directions, according to their location in the arch, which fact demands that the construction and application of artificial crowns should be made with a view of affording a degree of resistance sufficient to secure the greatest integrity of both.

As the line of the greatest natural resistance is in the vertical direction, every provision should be made tending to prevent undue and unnatural stress, which might ultimately cause displacement, trouble, or possible loss of the root.

In the anterior teeth the general tendency of the stress imposed is to

force them outward and forward, which may and should always be relieved as much as possible by the proper preparation of the root, the restoration of approximal contact, and the method employed for the attachment of the crown.

In the bicuspids the stress is received in both vertical and lateral directions, which demands a firm seating to accommodate the former and a strong method of anchorage to overcome the latter.

The molars are least susceptible to displacement for the reason that lateral stress is limited in proportion to the degree of the normal accuracy of occlusion; and as the greatest stress is in the direct or vertical line, the essential requirement is a good firm seating, supplemented by accurate occlusion.

**Articulation and Occlusion.**

The degree of usefulness and longevity of the artificial substitute depends greatly upon such formation of the articulating surfaces, and in the posterior region the arrangement of cusps and sulci in their relation to the antagonizing teeth, as will restore their normal functions. The arrangement should provide for correct position not only when the teeth are in direct occlusion, but also in their articulation or the act of bringing them into occlusion.

The evils of faulty and imperfect occlusion are often apparent, and result frequently in marked manifestations of virulent peridental and neurotic troubles.

**Approximal Contact.**

The restoration of approximal contact is of the greatest importance, and is made so because of the necessity for protecting the tissues in the interproximal spaces from the serious results of irritation.

These tissues promptly rebel against the slightest irritating influences to such extent as to demand the most stringent efforts toward their protection and preservation.

**Mechanical Relations.**

Due thought should be bestowed upon the method of attachment, fit and strength of artificial crowns, all of which are so necessary and add so materially to the durability and degree of permanency in the work from a mechanical standpoint.

**Method of Attachment.**

Two general methods of attachment are employed, each or either of which may be indicated by the style of crown required, and the amount of tooth structure to which the attachment may be made.

**Dowels.**

In roots which are even with or approximating the gingival line, attachment must necessarily be made by inserting a dowel in the direction of their longi-

tudinal axis to a depth, where possible, equal to the length of the crown from cervix to incisal or occlusal edge.

Such a mechanical fixation, whether the dowel be previously attached to crown or root, practically precludes the loosening of the parts from strain, at the line of junction, overcoming leverage at that point by distributing it throughout the length of root, and forms a most secure means of anchorage.

**Telescoping.** Where enough of the root is freely exposed to afford a firm grasp of the crown, the attachment may be securely made by telescoping, in which the strength at the line of junction naturally increases in proportion to the surface of tooth structure covered by the crown.

**Adaptation—Fit.** The relation existing between the crown and root is of the greatest possible importance, because the ratio of subsequent failure or trouble arising from the progress of caries, or from gingival or peridental irritation, is decreased in proportion to the degree of accuracy in the adaptation.

The crown should be seated firmly upon the root, and if no band is used the adaptation should be close enough to make a joint as flush and impervious as possible, so that the end of the root may be thus protected.

When a band is used, it should pass under or within the free margin of the gum a uniform distance on all surfaces of the tooth and *only* far enough to cover and protect the seam of union, which should be in such close proximity to the root as to preserve its continuity and make a smooth line of junction between the two.

**Strength.** The durability of this work depends to a very large extent upon its inherent strength, which it should always possess to a degree sufficient to permanently withstand the stress of mastication, even though it be gained at the sacrifice of more or less artistic results when occasion requires. Any tendency toward undue economy usually proves disastrous.

**Esthetic Relations.** These considerations embrace the field which gives the greatest possible scope to the individuality and artistic temperament of the operator, and while it is true that art can never entirely and completely take the place of nature, the aphorism is less applicable to this special line of work, perhaps, than to any other department of dentistry or of art.

To secure the highest artistic results, the artificial crown should preserve the gingival outline, and the symmetrical alignment of the teeth; should be proportionate in length with the adjacent teeth, and if of porcelain should closely match them in color, and should correspond favorably

in general form and characteristics with its fellow member of the opposite side of the arch.

As a rule, where porcelain is used no metal should be exposed to view from any surface, unless purposely done to more closely match the adjacent teeth or the corresponding tooth.

In instances where the remaining natural teeth are freely filled with gold, the artificial substitute should often carry fillings which will enable it to more closely resemble and harmonize with them, thus making detection more improbable, which legitimate deception is a true evidence of artistic endeavor.

# The Preparation of Roots.

CHAPTER VI.

Preliminary Requirements: Therapeutics. Feasibility of Devitalization: Physiological Considerations; Mechanical Considerations. Treatment of Hypertrophy, Free Exposure of the Root. Classification. Preparation for Shell or Telescope Crown: Requirements; Restoration of Continuity; Diminution of Coronal Proportions; Paralleling Converging or Diverging Teeth; Operative Procedure. Preparation for Shell or Telescope Crown with Porcelain Facing: Requirements. Preparation for Band and Dowel Crown; Requirements; Operative Procedure; Excising Incisors and Cuspids; Excising Bicuspids and Molars; Removal of Enamel: Use of Enamel Cleavers; Peripheral Trimming; Shaping Basal Surface. Preparation for Dowel Crown without Band: Requirements; Operative Procedure; Inseparable Dowels; Separable Dowels; Protection of Unsupported Walls. Preparation of Canals: Requirements; Operative Procedure. Treatment of Perforated Roots. Treatment of Fractured Roots: Posterior Teeth; Anterior Teeth, Prognosis.

Paramount among the obstacles in the pathway of success, permanency and comfort in crown and bridgework is the perfunctory, unskilful and profoundly indifferent methods so often employed in the procedure incident to the treatment and preparation of roots.

In the entire subject there is probably no one distinctive feature of such intrinsic importance as the practical, scientific and skilful preparation of the remaining crowns and roots of teeth, for the reception of artificial crowns.

While the proper and necessary operative procedure may be arduous, and replete with attending difficulties, the physiological and mechanical requirements are equally exacting, and demand the same degree of care, precision and accuracy that would be essential to the preparation of the foundation for any superstructure designed as a permanent evidence of skill and usefulness.

More particularly is this true in our efforts, because the field of labor is confined to living sensitive tissues which are so responsive to unnatural conditions that any apparent negligence must sooner or later manifest itself, not alone in evidences of failure, but also in the serious discomfitures accompanying the various stages of irritation.

These usually present in the nature of gingival inflammation, and peridental and alveolar absorption, to which conditions may be attributed a very large percentage of the troubles arising, and the absolute loss of many teeth. The common and exciting cause of such prevalent and sometimes discouraging results can invariably be traced to faulty and imperfect *adaptation* of the artificial crown, which in turn reverts, primarily, to inadequate and unskilful *preparation* of the root supporting it.

As clinical experience proves most conclusively that comfort and permanency depend upon a conservation or reproduction of the natural conditions, such liabilities decrease of course in proportion to the degree of accuracy observed in the operative procedure.

And as a degree of accuracy may only be obtained by an appreciation of the significance and importance of the requirements, a broad comprehension of the underlying mechanical principles, and a thorough, conscientious execution of the details is necessary.

To facilitate this the consideration of the subject must necessarily be in accordance with a more or less scientific and systematic arrangement, in the order of the practical application of the principles and technique involved.

## Preliminary Requirements.

When it has been determined that an artificial crown is indicated, the first essential features to be observed should always include a consideration of those requirements constituting the preliminary operative procedure incident to placing the roots in the most favorable condition possible for the subsequent permanent attachment of the crown.

**Therapeutics.** The very *first* detail is obviously that of the therapeutic treatment necessary in securing an *aseptic* condition of the root, including pulp canals and surrounding tissues.

This should invariably precede the removal or destruction of any of the remaining walls, because of the facility which their retention affords for the application of the rubber dam, which is essentially desirable and advantageous in rendering the field immune from secretions while medicinal applications are being made.

After the removal of all disintegrated structure, the usual remedial agencies indicated by the requirements and the existing conditions should be consecutively applied, until *thorough asepsis* of sufficient potency to preclude any possibility of subsequent disease or disintegration is obtained.

When this has been successfully accomplished, the pulp canals should be thoroughly filled throughout their entire length, irrespective

of the style of crown indicated, and the root filling then temporarily covered and protected with cement to exclude the deteriorating influences of moisture during its hardening and crystallization.

## Feasibility of Devitalization.

The problem of the feasibility of sacrificing the vitality of pulps in teeth which are to be subsequently crowned is one of great importance, and is a portion of the operative procedure incident to the preparation of such teeth, which requires the most conscientious and conservative consideration.

For many years no special thought was given to this feature, and such teeth as seemed to indicate restoration by crowning were treated much in the same manner as though fillings were to be inserted.

The frequency of subsequent troublesome manifestations, however, including the ultimate death of pulps with the attending consequences of such pathological conditions as virulent peridental inflammations and alveolar abscesses, have since caused the subject to be more carefully considered, until it is now most generally conceded to be a safer precaution, in a great majority of cases, to destroy such pulps as a prophylactic procedure as well as to facilitate the necessary mechanical preparation, when the crown is to entirely cover the end of the root.

**Physiological Considerations.**

It is now a more or less generally acknowledged belief of the most eminent authorities that the pulp is purely a formative organ, and that its physiological function terminates with complete development of the tooth; that it is not necessary to its vitality, stability and longevity after maturity, providing that the pulp cavity is perfectly filled; thus there seems to be no good reason for its preservation, taking into account the modern aseptic means of removing it and treating and filling the canals.

Especially is this true where a crown is indicated, because the abnormal encasing of the tooth so as to practically isolate it must at least diminish the external influences of secretions and temperature upon the nerve and blood supply of the pulp; and because usually such teeth have already been subjected to the irritating and devastating influences of caries, each of which seems but to invite and pave the way for ultimate destructive processes.

Other deleterious influences may come from the irritating action of the cements used in mounting, or from the effects of the *shock,* or overstimulation induced by the necessary mechanical preparation, either of which may often prove important factors in rendering such teeth susceptible to a "slow but often complete and unnoticed destruction."

All things considered, the prophylactic measure seems the conservative one, and as modern scientific root treatment offers no palpable excuse for subsequent pathological conditions, it seems that the orthodox dogma of *preservation* is inapplicable to a great majority of cases, where experience and judgment teach us the demand for a perhaps more "radical" but manifestly *safer* procedure.

The contraindication for such treatment would be in the mouths of patients under sixteen years of age, where in all probability complete development of the tooth had not yet been attained. In such instances, however, it would be as unwise to pass the crown entirely beneath the gum as it would be to destroy the vitality of the pulp, unless both were necessary. And after fifty years of age the necessity for such treatment is often greatly diminished because of the physiological phenomena of the gradual atrophy of the pulp, and the formation of secondary dentine, which so lessens the sensitiveness of the structure as to admit freely of the necessary preparation, while reducing the probability of the ultimate occurrence of pathological conditions to a minimum.

Occasional exceptions may also be warranted in those cases of abnormal development, faulty enamel formation, extensive abrasion as a result of attrition, and where the absence of adjacent and occluding teeth makes necessary but little, if any, preparation, but such indications can only be governed by experience and judgment.

**Mechanical Considerations.**

Because these considerations apply more particularly to the posterior teeth, where the shell or telescope crown is indicated, and where the removal of a considerable portion of the remaining tooth structure becomes an *absolute requirement*, the destruction of the pulp is usually imperative as a means of *making possible* and *facilitating* the necessary preparation in the diminution of the coronal proportions of the natural crown.

When the vitality is preserved, this procedure, always exacting, is ordinarily so *difficult* that it must be either perfunctorily and negligently performed, or else the patient must be made to tolerate an exceedingly and often excruciatingly painful operation.

Frequent evidences of flagrant indifference and negligence are so manifest as to prove conclusively that in a large majority of cases the vigorous efforts necessary to secure the best and most successful results may *only* be obtained under the most *favorable* conditions.

## Treatment of Hypertrophy.

In instances where an exuberant growth or hypertrophy of pulp or gum tissue is present, or may have almost entirely covered the end of the

root, some difficulty may be experienced in applying the dam and pursuing the necessary course of treatment..

Both may be greatly facilitated, however, by the immediate excision and removal of such tissue at the first sitting, and, if the continuity of the root be destroyed by disintegration, or if its length will not admit of the application of the clamp and rubber dam, a temporary restoration can be easily effected by adjusting a band of German silver closely encircling the circumference of the root, as soon as the suppression of the hemorrhage, by the use of styptics, will permit.

Such a band, if properly and carefully fitted to the neck of the root, and trimmed so as to have no sharp or irregular edges, and not to interfere with the occlusion, will at once admit of the application of the dam by adjusting the clamp over it, and may remain in place and be worn with comfort until the necessary treatment and final filling of the canals has been accomplished.

If filled flush to the edge with temporary stopping at the end of each treatment, it further serves to hermetically seal the dressing within the root, and to compress the tissues so as to afford a free exposure of the periphery.

## Free Exposure of the Root.

During the process of treatment in all badly broken down roots some means should *always* be employed to compress the tissues in such manner as to freely expose the end, which greatly facilitates the fitting of the band, or the adjustment of the crown, and materially lessens the usual discomfiture attending the operation.

When the use of a temporary band is not indicated, or seems unnecessary, the same advantages may be gained by packing temporary stopping into and over the end of the root, and *under* the free margin of the gum.

If the root is too shallow to anchor it securely, it may be so retained by packing tightly against the adjacent teeth, or held firmly by ligatures attached to them, or by inserting a small sharp tack through it and into the tooth structure.

In instances where the accumulation of gases demand some vent, a perforation may be made through the stopping at a convenient point.

Care should also be exercised to prevent *undue pressure,* which, if existing for an indefinite time, might possibly cause injury to peridental membrane or surrounding tissues, as a result of protracted lack of circulation.

## Classification.

The principles involved in the necessary preparation of roots are governed, of course, by the particular style of crown indicated, and, while crown work is divided into *two* general classes, according to the method of attachment employed, a variation in the essential details of their individual construction requires that each class be subdivided, and that the subject be considered in *four* general classes.

In order to meet the requirements occasioned by this variation, each class will be considered separately, and are as follows:

| | |
|---|---|
| Preparation for shell or telescope crown. | Preparation for band and dowel crown. |
| Preparation for shell or telescope crown with porcelain facing. | Preparation for dowel crown without band. |

## Preparation for Shell or Telescope Crown.

**Requirements.** The detail of procedure indicated by the requirements for a shell or telescope crown, because of being generally confined to the posterior teeth, is usually the most difficult, and should be closely observed.

**Restoration of Continuity.** In those instances where the ravages of extensive decay have caused the destruction of the remaining walls of the natural crown, so as to carry the cervical border at some point within or beyond the free margin of the gum, some means of permanent restoration of the continuity of the root is usually advisable.

This prevents the possible fracturing of unsupported walls during their preparation; adds materially to the integrity of the root; greatly facilitates the fitting of the band, and overcomes the probability of subsequent disintegration arising from an imperfect adaptation of the band to the margins of deep cervical pockets.

Such restoration can usually be best accomplished with *amalgam,* the use of which affords a better opportunity for securing a close adaptation between it and the margins of the root, with the assurances of a greater degree of permanency.

Where the edge of the band, however, *can* be fitted closely to the root at all points around its entire circumference, with a reasonable degree of certainty, and where the walls are weak, the use of cement for this purpose is preferable, because of the additional support rendered by its adhesive qualities, and because any further destruction of the tooth

structure for the purpose of securing retention is unnecessary; but when the extreme depth of the marginal edge (Fig. 32) makes a close adaptation of the band either *impossible* or *doubtful,* amalgam should be used.

In using amalgam adequate retention must be secured in the pulp chamber, or root canals if necessary. A thin circular matrix of German silver, g. 34-36, should then be adapted, and so shaped as to make the restoration of suitable form to save further preparation. After adjusting this, its inner surface should be coated with vaseline, oil, or any lubricat-

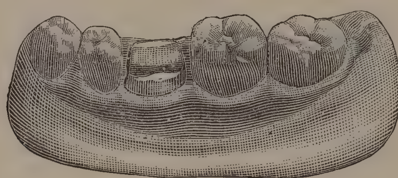


Fig. 32.

ing substance, to prevent adherence of the amalgam, and insure its easy removal after crystallization. To admit of and facilitate this the amalgam should never extend as high as the edge of the band, and a subsequent sitting is usually necessary. (Fig. 33.)

In roots where the entire crown has been destroyed, it is usually necessary to rebuild and restore a portion of it, in order to better and more securely sustain the artificial crown, by obtaining greater integrity between it and the root at the line of junction. This may be easily ac-

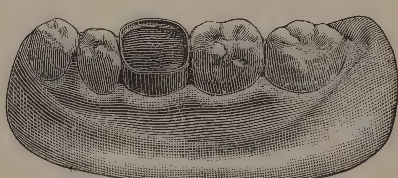


Fig. 33.

complished by adjusting the matrix, and firmly inserting a screw-post into the most accessible canal, additionally fortified with cement (Fig. 34), and then building up with amalgam to the desired length and shape.

**Diminution of Coronal Proportions.** The diminution of the natural crown, or its remaining walls, in a manner favorable to the requirements, is frequently a very difficult procedure because of the usual inequality, in teeth of normal proportions, between the diameters of the crown and the cervix.

This requires and necessitates the removal of considerable tooth structure in order that the circumference may be reduced at every point occlusally, and at the uniform expense of each surface, *at least equal* to the exact dimensions at the cervix.

While it is, of course, desirable to leave as much as possible of the remaining coronal portions, it will be observed from the illustrations (Fig. 35) that approximately about one-sixteenth of the structure from the axial walls, and the occlusal one-fourth must be removed.

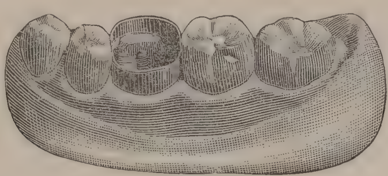


*Fig. 34.*

Such a requirement is not a hypothesis, but a physical and mechanical problem which must necessarily be closely observed, in order that it may be made possible for the band to approximate a close adaptation to the normally constricted neck; and to admit of a reproduction of the occlusal surface in the artificial crown possessing sufficient thickness to withstand the influences of constant attrition.

To further increase the opportunities for securing a closer continuity between crown and root, the remaining walls should not merely be parallel,

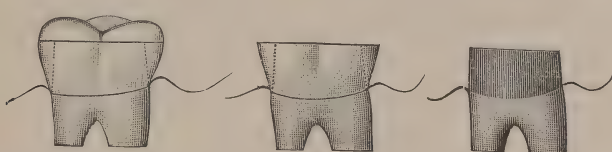


*Fig. 35.*

but should be slightly *inverted,* so that the band may *fit more closely as it is pressed rootwise,* and thus prevent its edge from being forced *into* the gum tissue, instead of *under* or *within* the free margin.

This requirement is indisputably essential when the crown is intended to approach or pass beneath the gum, if comfort and permanency are to

be obtained from the operation, and is one of the strongest arguments in favor of the devitalization of the pulp.

**Paralleling, Converging or Diverging Teeth.** Owing to the general tendency of teeth to gravitate or tip toward the unoccupied area in interrupted arches (Fig. 36), in their preparation for bridgework it is essential to observe that the surfaces of each individual root presenting toward each other, are made absolutely perpendicular, as illustrated in Fig. 37.

Such a condition will frequently be found, and no matter how per-

*Fig. 36.*

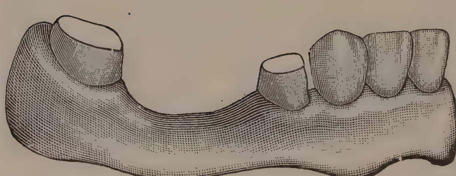


*Fig. 37.*

fectly each individual root should be prepared, the presentation of perpendicular lines is necessary to admit of the adjustment of the bridge after completion.

## Operative Procedure.

As this portion of the operation is particularly trying to the patient, as well as the operator, a good assortment of stones, disks and burs, kept sharp, even-edged, and mounted true, is essential, and all unnecessary grinding should invariably be avoided.

When any of the walls of the tooth remain or approximate their full length, the first detail should be to undermine the enamel to the desired point by cutting away the dentine with a sharp bur. Such walls may then be easily broken down with the excising forceps, and much unneces-

sary grinding thus avoided. The surface of the occlusal end should be ground smooth with a thick-edge stone. The buccal and lingual walls may be reduced with a *thin-edge* stone of suitable diameter, in which it is essentially necessary to keep the revolving stone moving upward and downward against the surface of the tooth, to prevent the formation of a shoulder or ridge at any point, and to assure a uniform reduction.

After these walls have been adequately reduced, the trimming of the approximal walls, usually the most difficult, is next in order. When they

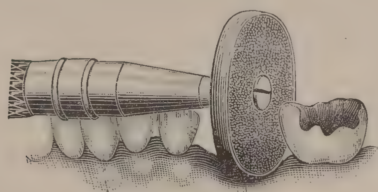


Fig. 38.

remain high enough to afford considerable support to the enamel, grinding must still be resorted to, as the cleavers will be found practically useless in detaching and removing it unless it is more or less disintegrated.

For such purposes a thin-edge stone or diamond disk of suitable diameter may be used, by beginning from the occlusal end, at a point about one-sixteenth of an inch from the periphery, and cutting through on a slight angle until the interproximal space is reached.

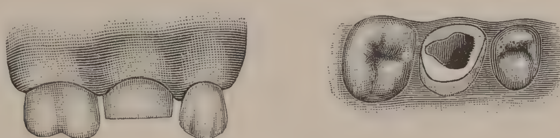


Fig. 39.

A small cross-cut fissure bur inserted into the interproximal space at right angles to the teeth, and brought occlusally with considerable pressure against the root, may often serve as a valuable supplement to the stone, or sometimes answer the purpose itself, if sufficient care be exercised to prevent mutilating the adjacent teeth, which may often be protected with a band matrix.

When adjacent teeth are absent, the procedure is less difficult, and may be accomplished with a blunt safe-edge stone, as illustrated in

Fig. 38, or a stone possessing the shape of an inverted cone. The latter is very often found most useful in reducing the surfaces of molars.

If the remaining walls are short, and the enamel is somewhat disintegrated, the *cleavers* may be found very useful.

When sufficient diminution of the structure has been secured, the sharp corners should be nicely *rounded* with burs and sandpaper disks, and the necessary preparation is then completed.

The degree of accuracy thus obtained will be denoted by the freedom and facility with which the measurement wire may be detached from the root after being twisted taut, and the buccal and occlusal aspects should present, as indicated in Fig. 39.

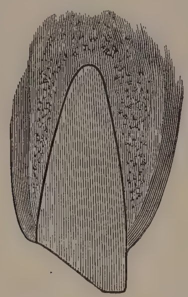


Fig. 40.

## Preparations for Shell or Telescope Crown with Porcelain Facing.

**Requirements.**

While the same general principles apply to the necessary preparation for a shell or telescope crown with porcelain facing, and the same detail of procedure is indicated, a variation is required.

This variation comprises grinding down the buccal wall sufficiently to accommodate the presence of the facing, as the area to be occupied by it must, of course, be gained at the expense of the remaining root. (Fig. 40.)

This should never be done, however, until after all other requirements, as before outlined, have been observed, and it may be done to even better advantage after the band has been fitted.

## Preparation for Band and Dowel Crown.

**Requirements.**

The requirements of root preparation for a band and dowel crown are similar in peripheral features to the requirements for a shell or telescope

crown, but differ in that *all* of the remaining natural crown must, of course, be sacrificed to more nearly approximate the gum line.

This is necessary because the line of junction between crown and root is made at this point in order to accommodate the artistic and esthetic presence of a porcelain facing.

## Operative Procedure.

In the operative procedure incident to removing the remaining portions of the natural crown, as much of it as possible should be cut away and broken down to a certain point, in order to avoid all unnecessary grinding.

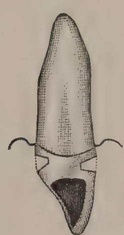


Fig. 41.

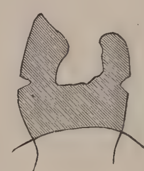


Fig. 42.

**Excising Incisors and Cuspids.**

In the incisors and cuspids this may be quickly and easily accomplished by first undermining the remaining enamel with a bur, and then cutting grooves through it at a point which, when the crown is excised, will *leave a projecting end of the root* about one-sixteenth of an inch *beyond the gum line*. (Fig. 41.)

Care should be exercised in cutting the grooves entirely through the enamel, so as to relieve or reduce the shock, and prevent a fracture rootwise. The beaks of the excising forceps may then be placed in the grooves, and the crown easily and safely removed.

**Excising Bicuspids and Molars.**

In removing the remaining portion of the crowns of bicuspids and molars, the grooves and excising forceps possess the same advantages.

In their use, however, any remaining *continuity between buccal and lingual walls* must also be first attacked with a bur to destroy their integrity. (Fig. 42.) This, in conjunction with grooves, will facilitate their excision without shock or danger of fracture.

**Removal of Enamel.** The remaining ledge of enamel upon this projecting end of the root, which has been purposely retained, for the time, must then be removed in order to bring the greatest diameter beneath the gum, where the line of junction between band and root is to be made. This can be best accomplished by the use of enamel cleavers designed for the purpose.

**Use of Enamel Cleavers.** The use of enamel cleavers of any design may or may not be of a desired degree of effectiveness; according to the manner in which they are manipulated, and the easy and expeditious removal of enamel depends entirely upon their proper manipulation.

The edge of the cutting blade of the instrument must be placed above the enamel and held at the *proper angle* in its relation to the surface of

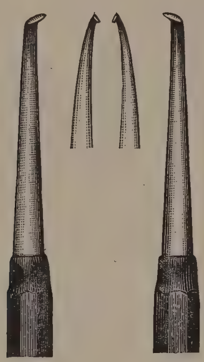


Fig. 43.

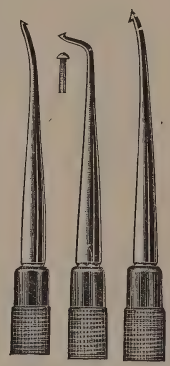


Fig. 44.

the root; and a *fulcrum* must be established to facilitate the application and exertion of the necessary force to secure the destruction of what is usually a very dense attachment.

The adjacent teeth, when present, will serve as a means of establishing such a fulcrum; and in their absence the same may often be secured by placing a smooth piece of soft wood or rubber, of sufficient thickness, against the incisal or occlusal ends of remaining teeth, or the gums, against which the thumb may rest as a means of affording opportunity for securing purchase and leverage.

While various styles of instruments have been suggested for this purpose, those designed by Dr. C. S. Case (Fig. 43) will be found admirably adapted to upper anterior roots; and those designed by Dr. A. G.

Johnson (Fig. 44) are especially useful for posterior and lower roots, though adapted for universal use. The manner of holding them in the hand and securing purchase upon adjacent teeth is illustrated in Fig. 45.

**Peripheral Trimming.** After all enamel has been removed, the periphery of the root should be made smooth and to present a perpendicular line, as indicated before and after in Fig. 46. This can be easily accomplished with a small fissure bur; or, a set of trimmers suggested by Dr. J. H. Prothero (Fig. 47), or the "Root Reducer," manufactured by the S. S. White Co. (Fig. 48), both of which are designed for this purpose, and may be found useful.

*Fig. 45.*

*Fig. 46.*

*Fig. 47.*

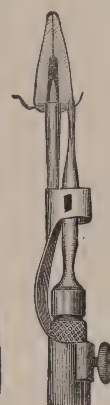


*Fig. 48.*

**Shaping Basal Surface.** Before considering the final shaping of the end or basal surface of such roots, it may be well to emphasize that they have been *purposely* left projecting somewhat beyond the gum, as indicated, until the peripheral preparation is complete, because of *thus materially facilitating* the removal of enamel, and the subsequent taking of the measurement and fitting of the band, and for the reason that this freely exposed and projecting surplus end serves to retain the wire until an accurate measurement may be secured, and to *conform the band to the proper shape and guide it to place in fitting.*

The fitting of the band is thus made practically free from discomfiture to the patient, and easy for the operator, and after it has been fitted and trimmed to the desired width, the root should *then* be cut down to the proper form of base.

The shape given the basal surface of the root is of much importance, and particularly in the upper anterior teeth, where the requirements make it desirable to leave the lingual edge somewhat longer than the labial in

order to afford greater mechanical resistance to the stress naturally imposed, and to carry the labial edge a trifle beneath the gum, so that the band or cap may be *invisible,* and the neck of the porcelain facing placed in close proximity to the gum line.

Compliance with these mechanical and esthetic requirements results, of course, in beveling the end of the root, as indicated in Fig. 49 (which

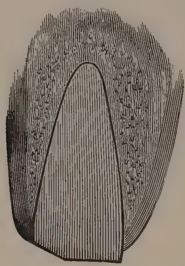


Fig. 49.

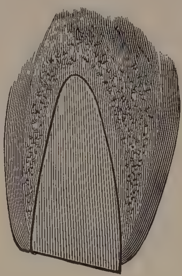


Fig. 50.

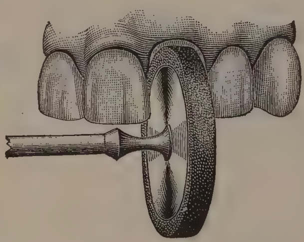


Fig. 51.

is the common practice), or in shaping it on a slight and gradual *inclined plane,* as illustrated in Fig. 50. The latter is the best and preferable preparation, because of affording greater opportunities for the adaptation of the cap and facing without causing undue prominence at the neck (a common fault with artificial crowns), and with a minimum of grinding of the facing, and a maximum of strength in the crown.

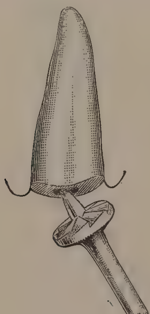


Fig. 52.

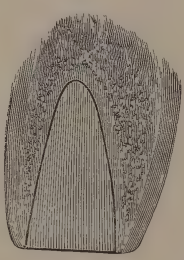


Fig. 53.

This can be best accomplished with a flat-edge carborundum or "vulcan" carborundum stone (Fig. 51), kept wet when using (the latter having the advantage of wearing true), until the gum line is reached, when the Ottolengui root-facers (Fig. 52) are most useful in cutting it beneath the gum on the labial or buccal edges, without lacerating the tissues. These should be of the *"safe-sided"* variety, and are made in

three sizes, to accommodate the size of root and the space between adjacent teeth, and should be used with extreme care, as they cut rapidly.

In the preparation of bicuspid and molar roots, where the stress is *direct,* it is usually desirable to leave the basal surface almost *flat,* as indicated in Fig. 53. This allows more opportunity for securing strength in the finished crown, and adds to the possibilities for its closer adaptation and for an observance of the more artistic and esthetic requirements.

In *no instance,* however, should this final preparation be made *until the band has been fitted.*

## Preparation for Dowel Crown without Band.

In the preparation of roots for the dowel crown *without* band, the same procedure applies to the removal of the remaining natural crown, as indicated in the preparation for this style of crown with a band.

**Requirements.** After the remaining portions of the natural crown have been sacrificed, however, the essential features differ somewhat in the shape given to the basal surface, and in that the removal of enamel, or any peripheral preparation, is, of course, entirely unnecessary.

## Operative Procedure.

As the permanency and success of such crowns depend, to a great extent, upon the degree of accuracy secured in the adaptation to the root, its end must be so shaped as to render the opportunities for a close adaptation most favorable.

**Inseparable Dowels.** In the preparation for that style of crown in which the dowel is an integral part (as the Logan crown), the form given to the basal surface should be exactly as indicated before, in Fig. 50, and the procedure is identical, *excepting the removal of enamel.*

This preparation becomes necessary because the presence of an immovable dowel makes the grinding of the crown to adaptation with the root somewhat difficult at best, but which is facilitated, of course, by having the root present as smooth a surface as possible. The labial surface may then be brought in contact with the gum margin, which is desirable for esthetic reasons, while the line of junction upon the lingual surface will be in accord with prophylactic measures in being rendered self-cleansing by exposure to the secretions and movements of the tongue.

**Separable Dowels.** The difficulty in adapting such crowns because of the interference of the dowel in grinding, constitutes the advantages possessed and afforded by those with separate dowels, such as the Davis crown.

**Plate and Dowel.** Where it is intended to construct the crown with plate and dowel as separate parts, to be subsequently attached with solder, and where the close adaptation of the plate may be secured by swaging or burnishing, the lingual portion should also be beveled almost to the gum line. (Fig. 54.)

By thus *saddling* the end of the root, greater mechanical resistance

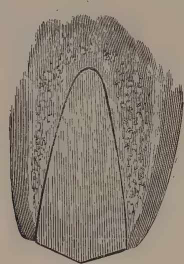


Fig. 54.

is offered to the displacement of the crown, while the prophylactic requirements are secured in a better adaptation of the surface, and a closer approximation of the edge of the plate to the periphery of the root.

**Protection of Unsupported Walls.** In roots which present a concave base as the result of extensive decay, the walls should first be ground down until smooth, and as dense as the marginal outlines noted will admit, and then supported with a suitable material.

When the *continuity remains unbroken,* cement will best answer the purpose, but if some restoration seems necessary, the use of amalgam is usually indicated for the reasons mentioned.

As mechanical retention is frequently impossible, in these roots, some difficulty may be experienced in anchoring it where its use is indicated, but this may be accomplished by first thoroughly roughening or serrating the dentine with a wheel-bur, and then flowing over it a thin coating of cement and immediately packing the amalgam to place.

The cement thus aids materially in securely anchoring the amalgam, and a more permanent restoration is often afforded.

In very extensive decay these walls may sometimes be better sup-

ported by forming the base of the crown itself to closely fit them, so as to offer the necessary protection when mounted with cement.

## Preparation of Canals.

The preparation of the canal for the reception of the dowel should always be the last procedure, and is of special significance since the dowel plays such an important part in the retention and stability of this style of crown.

**Requirements.** The necessary preparation consists in enlarging them sufficiently to receive a dowel *proportionate in size with the diameter and probable length of the root, and consistent with the requirements of the crown.* Any further enlargement and destruction of tooth structure is injudicious and unnecessary.

One dowel is sufficient to support any crown, *providing* that it may extend into the root a depth *equal* to the length of the crown (Fig. 55),

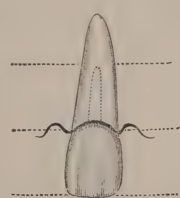


Fig. 55.

which is a mechanical requirement, and possess strength enough to withstand the stress.

In upper first bicuspid and in molar roots, however, if the probable length or constriction of the root precludes this, two may be used.

**Operative Procedure.** After first so determining the size of dowel indicated, or to be used, in the individual case, the canal should then be enlarged to receive it. A twist drill or sharp round bur approximating the same diameter as the dowel should then be selected, and the canal reamed out to adequate proportions.

In most instances it is desirable to extend the opening into the canal somewhat lingually, in order to permit the dowel to pass through the cap at a point which will carry its projecting and surplus end out of the way, so as not to interfere with the adjustment of the neck of the facing to proper relation.

Considerable care should be exercised, especially in bicuspid and

constricted roots, to avoid drilling through the sides of the root, as such perforations usually cause much trouble, and may often result in the loss of the root.

For this reason the round bur is considered the best and safest means of enlarging canals, because if of a proper size, and carefully guarded, as it approaches the periphery an immediate response will be manifested from its approaching proximity to the peridental membrane, in ample time to cause cessation of drilling and prevent perforation of root.

## Treatment of Perforated Roots.

The presentation of perforations through the root, whether from accidental causes or as the result of caries, is usually a most aggravating state of affairs, and calls for much painstaking effort to again place such a root in condition to remain permanently comfortable.

A hermetical and non-irritating seal is required, for which purpose soft gold foil, tin foil, cement, white paraffin and gutta percha are generally used.

While all possess some good qualities, the use of chemically pure tin foil is most universally successful.

When these cases present, all septic and inflamed conditions of immediate and surrounding tissues should first be relieved by the proper medicinal applications. A small cone of chemically pure tin foil, about No. 4 thickness, should then be rolled, and inserted into canal, until one end is passed through the perforation. With a smooth, blunt, root canal plugger, the remaining portion of the cone should be gently packed against the walls over and surrounding the perforation, and then small pellets of slightly moistened cotton should be packed into the canal to burnish the tin to close adaptation.

Upon the removal of the cotton the tin may be protected and held in place by covering with chloro-percha and filling the root with cement.

When such treatment becomes *necessary before* filling the canals, their location may be preserved to admit of same by the insertion of a broach into each, the subsequent removal of which will leave them still accessible for further treatment and final filling, through the openings thus made.

The use of tin is preferable to other materials, because it is easily adapted, even in the presence of moisture, and is absolutely non-irritating, and offers a still greater advantage in the *hermetical* sealing afforded by the subsequent formation of the *oxide*, which chemical action is induced by contact with the moisture of the tissues.

## Treatment of Fractured Roots.

The not infrequent presentation of fractured roots, and the difficulties usually encountered in their treatment, require a definite knowledge of the various means employed to restore and preserve their usefulness, and a delicacy and dexterity of manipulation in the procedure.

**Posterior Teeth.** In the posterior teeth these conditions usually result from overstrained or undue masticatory force upon such teeth as may have been weakened by the presence of extensive decay, or very large fillings, involving the approximal and occlusal surfaces, and causing a longitudinal fracture of the remaining crown and root.

Such fractures usually extend from mesial to distal surfaces, separating the buccal from the lingual cusps, and may often be successfully treated and permanent usefulness restored by crowning the root.

When such a course seems indicated, the first procedure should be the

Fig. 56.

thorough removal of all loose particles, by freely washing and flooding the tooth with tepid water, until a perfect and close approximation of the parts may be secured.

This approximation should then be securely retained, temporarily, until permanent fixation may be obtained by mechanical means. This may be accomplished by using well annealed German silver, or ordinary silver suture wire, from 23 to 26 g., which should be passed around the circumference of the tooth at the neck, and the ends then twisted tightly together.

The German silver wire is preferable because of admitting of greater strain without breaking, and if therapeutic treatment is necessary it may then proceed until the tooth and adjacent tissues are placed in favorable condition.

The mechanical procedure then necessary to firmly and permanently anchor the parts is governed by the extent of structure possessed by each independent portion.

If enough remains of each portion, they may be securely attached by cutting dovetail grooves in each, and then flowing a thin layer of cement over the entire interior surface, thus utilizing its adhesive properties, and then filling with amalgam. (Fig. 56.)

When the latter has become thoroughly craystallized, the wire may be removed, and the tooth carefully shaped for the reception of the crown. When insufficient structure in one of the parts precludes this procedure, the desired result may be accomplished by first wiring securely, and then adjusting the rubber dam and completely filling the tooth with thin cement.

If the presence of moisture is prevented, the adhesive properties of the cement, in conjunction with the wire around the neck, will usually retain the parts until the tooth has been shaped, if *care* be exercised. In this particular, the stone should *always* revolve toward the fracture in order to prevent displacement.

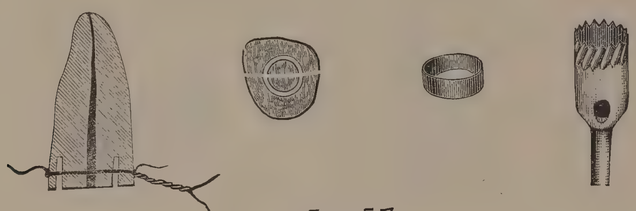


Fig. 57.

The wire may then be removed, and the crown fitted and mounted.

**Anterior Teeth.** Such fractures in the anterior teeth usually occur as the result of a blow or other accident; or from the stress of mastication upon an artificial crown offering no protection against such strain and perhaps mounted upon a root already weakened by too extensive or injudicious enlarging of the canal for the reception of the dowel.

When the fracture does not extend beyond the border of the alveolus to any appreciable extent, it is usually best to remove the loose portion, compress the tissues with gutta percha, and restore with amalgam. Or if the necessary retention is not possible, the base of the crown may be closely adapted to the root, and the restoration made with the crown.

When the fracture extends *beyond* the alveolus, however, it is usually desirable to secure fixation and retain the loosened portion, in order to prevent the resorption following its loss.

This may be accomplished by cementing and wiring until sufficient preparation can be made to admit of the adjustment of the crown.

If each portion possesses sufficient structure, additional strength may often be secured in their fixation by the use of an *intradental band.*

Where the length and thickness of the fractured part may seem to indicate such a procedure, the parts should first be tightly wired, as suggested, and then a circular groove trephined a consistent depth through the thickest part of each, into which a band may be subsequently fitted (Fig. 57), by the use of a very simple outfit suggested by Dr. B. J. Cigrand. When the band has been adjusted to the groove and ground smooth with the basal surface of the root, a firm secure fixation of the parts is insured, and the wire may then be removed and the crown adjusted.

**Prognosis.** While some little suppuration and trouble may be subsequently present as a result of reuniting fractured roots, it should give no unnecessary apprehension because if properly treated, and absolute immobility has been secured, it is usually of but temporary nature, and many roots so treated seem permanently restored to usefulness, indicating a very favorable prognosis.

# The Shell or Telescope Crown.

## CHAPTER VII.

Indications, Contraindications, Requirements: Telescoping Portion, Occlusal End, Methods: Sectional Method, Procedure; Measurement, Bands; Width, Length, Soldering, Fitting, Contouring, Occluding Bite, Impression. Articulators. Processes for Cusp Formation, Carved Cusp and Special Die Methods. Procedure; Swaged Cusps, Mould, Dies, Swaging, Adjusting Cusps, Soldering Cusp, Finishing. Solid Cast Cusps. Cusp Formation without Models. Use of Ash's Crown Swaging Device. Die and Die-Plate Methods; Individual Dies, Die-Plates; Application, Adjusting With Models. Adjusting Without Models. Hollingsworth System; Application. Millett's System, Application. Lowry System; Application. Baird System; Application. Seamless Method: Advantages. Disadvantages; Time, Strength, Adaptation. Detail of Construction; Primary Band, Bite and Impression, Preparing Model, Casting Flasks, Dies, Forming Blanks, Swaging, Adapting and Re-enforcing. Reverse Process: Advantages, Disadvantages, Procedure; Original Model, Mould, Swaging-Model, Blanks, Swaging, Methods, Scott's Method, Finishing. Application to Separated Molar Roots; Procedure, Bands, Cusps. Application to Individual Roots. Cantilever Bridges. Application of Amalgam: With Band, Without Band. Application to the Anterior Teeth: Indications, Procedure; Adaptation to the Mouth. Adaptation to Models. Carving and Swaging. Die-plate Methods; Lowry and Millett Systems; Hollingsworth and Baird Systems. Seamless Method: Reproductions. Dowels. Ready-made Forms. Removing and Repairing; Crown Slitting Forceps. Preserving Continuity of Bands. Repairing.

Brief reference has already been made to the history and usefulness of the gold shell or telescope crown, and to this style of crown as having been one of the early achievements in the preservation of badly decayed teeth or roots, and the restoration to their former functional activity.

Regardless of the progress and development of crown work in general, however, and irrespective of the esthetic and hygienic advantages of porcelain work, this style of crown is still, and probably always will be, one of the very best means and methods of subserving the requirements. Indeed, when their application is indicated, and when the adaptation and construction, by whatever method chosen, is practically and skilfully executed, no other one method of procedure seems to offer so great an opportunity for the serviceable and permanent reproduction of the normal condition.

As a natural consequence, and because of the time-proven value of a method affording such opportunities and possessing the possible qualities of strength and indestructibility to so great an extent, many roots have been permanently saved and made useful that would otherwise have been lost; bridge-work, both fixed and removable in character, has developed and become practical; and yet the esthetic and artistic possibilities of modern prosthesis have been most flagrantly abused by injudicious use, and indiscriminate application.

If dentistry is to become universally acknowledged as a profession embracing a field of dignified and scientific pursuit, and if dental prosthesis is ever to be accorded the recognition and distinction of an *art,* to which the scope of its possibilities entitle it, the somewhat common practice of placing gold crowns on teeth, within the range of vision in the mouth, violating all traditions of art, must be considered as degrading, and should be most vigorously condemned.

No matter how skilfully the operation may be made, or how perfect the result obtained, such evidences of artificial handiwork whenever prominently conspicuous are an offense to art, culture and refinement.

As a result of the appreciation by the laity of more artistic endeavor, and their education at the hands of those conscientious enough to exercise their *duty,* the request for such work is now so limited, and so few will even tolerate them, that the pernicious practice is of necessity confined mostly to either unscrupulous charlatans, or to those who wilfully cater to a perverted taste and a barbaric vanity.

**Indications.**

As many teeth requiring artificial crowns, however, are beyond the range of vision, gold crowns may often be used without objection, and to the best possible advantage.

Their application is indicated, principally in restoring the roots of molars, and occasionally of second bicuspids, but rarely anterior to them.

In cases of close occlusion, where the cusps of the opposing teeth when brought into direct occlusion afford but little, if any opportunity for securing sufficient strength with any style of porcelain crown; and on roots so short, disintegrated and weakened as to require support and restoration with amalgam, especially in the mouths of men where their presence may not be conspicuous because of the beard, their application to the *first* bicuspids may be sometimes permissible; also in the preparation of bicuspids which are to serve as abutments for bridgework, where it seems advisable to allow the natural crown to remain as long as possible, in order to afford greater integrity in the attachment of the artificial crown, and thus secure increased mechanical resistance to the stress imposed upon the bridge.

**Contraindications.** Anterior to the molars, however, and particularly in the mouths of women, their application is usually contraindicated in view of the more artistic means available. Any exceptions should be based only upon a conscientious consideration of the existing conditions and practical requirements of the case; and their application to the incisors and cuspids, in any event, should be regarded as an unpardonable offense.

## Requirements.

The requirements for this style of crown do not differ essentially from those of crown work in general, as previously outlined. Whenever and wherever employed, they should be constructed of a material thick and heavy enough to possess adequate strength *when finished,* and sufficiently high in karat to withstand the chemical action of the secretions.

**Telescoping Portion.** The band or that portion which telescopes the end of the root should fit closely around the entire circumference; pass a *short,* but *uniform,* distance beneath the gingival border of the gum, and possess a smooth *rounding* edge so as to offer no possible irritating influence to the tissues surrounding it. It should also be contoured to typical form, restore the points of contact, and preserve a proportionate and symmetrical alignment, with the adjacent teeth.

**Occlusal End.** The cusps forming the occlusal end should mimic or approach a typical reproduction of the individual tooth; restore the normal occlusion by contact with opposing teeth at several points, and offer no interference to the lateral motion of the jaw in the various movements of articulation.

They should also be deep and sharp enough to aid in the act of mastication, and of sufficient thickness to withstand constant and continued attrition.

A very common fault with a large majority of these crowns is the presentation of a more or less smooth and uninterrupted masticating surface. Such a condition precludes the proper mastication of food, and minimizes the possibilities of service and usefulness, which may be easily obtained, and which qualities such substitutes for the natural condition should always possess.

## Methods.

The general usefulness of this style of crown has resulted in the presentation from time to time of an innumerable variety of methods and systems for their construction.

The degree of skill possessed by, and the personal preference of oper-

ators enter into the use of all of them to such an extent as to have so far prevented the adoption of any particular one as a universal system.

Two general methods of construction are employed—the *Sectional* and the *Seamless,* and each has many diversified processes.

**Sectional Method.** The sectional method, wherein the band and cusp are made separately and subsequently united, is the most commonly used. This procedure seems to afford more absolute accuracy in securing adaptation; even better opportunities for the reproduction of the necessary contour; consumes less time, and admits of the use of a heavier gauge of gold throughout the construction of the crown. These important advantages cause it to be readily accepted as the most universally successful method.

The joint made in the union of band and cusp offers no objectionable features, and in no way interferes with artistic possibilities, if the edges

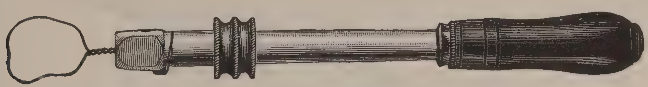


*Fig. 58.*

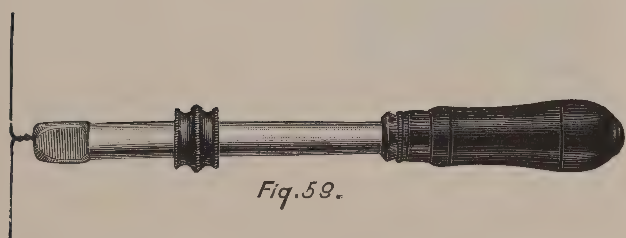


*Fig. 59.*

of each are closely and perfectly approximated, and the union made with a solder closely resembling the gold in color, and sufficiently high in karat to withstand the chemical action of the secretions without subsequent discoloration.

**Procedure.** In the procedure incident to the mechanical construction of a crown possessing a band by any method, the first detail is obviously that of securing a true measurement of the diameter of the root to serve as a positive guide in obtaining a band of accurate dimensions.

**Measurement.** For this purpose wire, thin, narrow copper strips, and waxed floss are used. Bessemer steel wire, about No. 32, is preferable, however, because of being easier to adjust and handle, and more reliable.

It should be cut in suitable length, made in circular form, somewhat larger than the root, and the ends then securely attached in a small dentimeter, avoiding any unnecessary surplus.

While many varieties of dentimeters have been suggested, a small jeweler's slide pin-vise affords the quickest, easiest and most secure adjustment, with less danger of cutting the wire when twisting.

The loop of wire should be then placed over the root, passed just freely beneath the gingival border of the gum, and twisted taut, being careful in the meantime to conform and adapt it to all concavities of the root. Fig. 58.

In very short roots, it may become necessary to hold it under the gum with a suitable instrument, to prevent displacement while twisting; and, while it is usually most convenient to have the twist upon the buccal

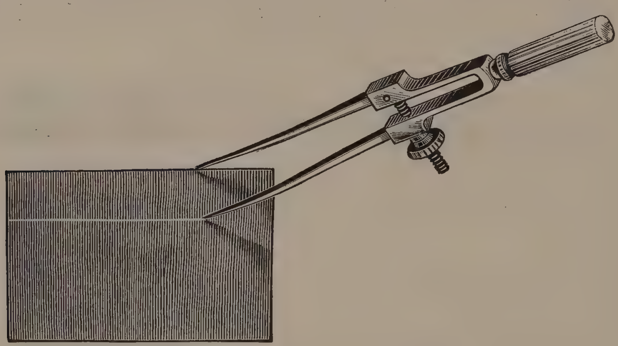


*Fig. 60.*

or labial surfaces, in second and third molars it may sometimes be found more convenient to twist from the lingual surface.

After securing the correct measurement of the diameter of the root the wire should be cut in two at a point farthest away from the twisted portions, and each end of the former loop then carefully straightened out until smooth, continuous with one another, and at right angles with the dentimeter. Fig. 59.

When two or more crowns are being constructed for the same mouth at the same time, especially when the roots are nearly of a size, each measurement should possess some characteristic to distinguish it from the other, by which means any confusion in the subsequent fitting of the band may be avoided. This may be easily accomplished by so bending or shaping the surplus ends as to differentiate between them, and have each designate the root which it represents.

**Bands.** As the strength possessed by the crown, in its attachment to the root, increases in proportion to the thickness of the gold of which the band is made, so long as it is not *too* heavy to be easily manipulated and accurately adapted, and as gold stretches easily, and its thickness is necessarily diminished by the subsequent process of finishing and polishing, 28 gauge (B. & S.) plate, about 22 karat in fineness, should be used for bands. A gold for this purpose is especially prepared by the Consolidated Dental Mfg. Co. which is alloyed slightly with platinum, and possesses the advantages of strength and toughness as well as being non-oxidizable, by which name it is designated.

**Width.** The desired width of the band should be noted with the eye, or, if necessary, measured with a piece of cardboard trimmed to the correct width, or with a small compass. Fig. 60.

**Length.** In cutting the gold the cervical edge, or that which is to be fitted to the root, should be the *exact* length of the measurement wire; but the variation or

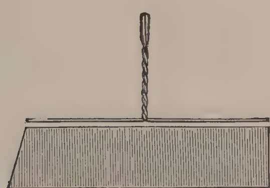


Fig. 61.

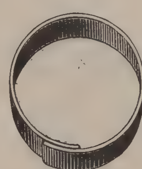


Fig. 62.

inequality between the diameter of the root, in proportion to the dimensions of the space to be filled by the crown, to obtain the most artistic results, often requires that one end of the band be cut on such an angle as to make a difference between the circumference of its cervical and occlusal edges when soldered. Fig. 61.

While perfectly straight edges will often afford sufficient opportunity for the necessary shaping and contouring of the occlusal end, it is frequently desirable and sometimes necessary to have this edge of slightly larger proportions, especially in bicuspids, in order to more perfectly and artistically meet the requirements of contact and alignment.

Where the root is proportionately larger than the space to be filled, however, the converse of the proposition may be indicated, in order to secure and preserve an alignment of the occlusal surfaces. In such in-

stances the edges should be cut *straight,* in order to facilitate the adaptation to the root, after which the circumference of the occlusal edge may be adequately reduced.

**Soldering.** When the band has been properly cut it should be annealed, the edges filed smooth, so as to approximate evenly when brought into contact, and then given circular form. Perfect contact of the edges is essential to insure fit and facilitate soldering, and may be sustained by first *overlapping* and then bringing them back into direct contact. (Fig. 62.) This procedure condenses the molecules sufficiently to overcome the expansion, when heated, that would otherwise cause a separation, and is preferable to wiring the outside circumference of the band because the solder not infrequently penetrates the joint and attaches the wire to the gold, which necessitates its being ground off afterwards.

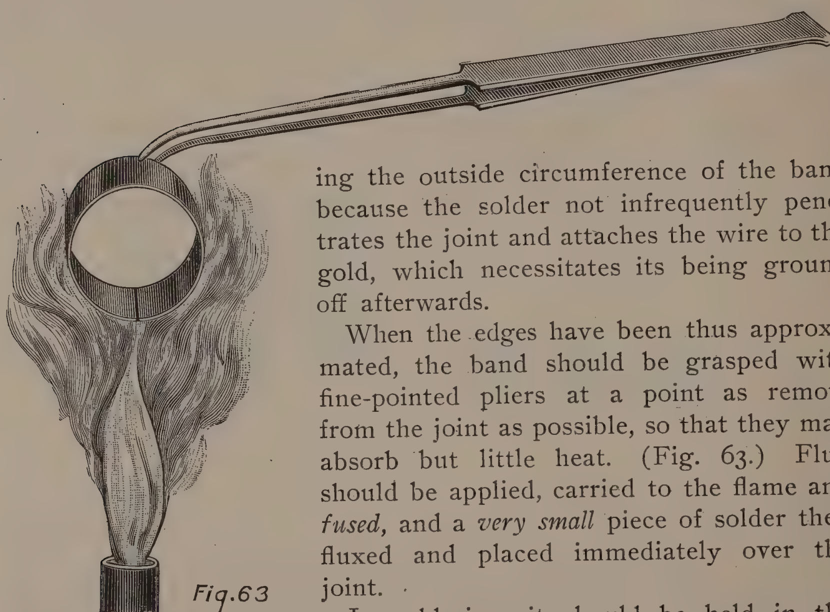


Fig.63

When the edges have been thus approximated, the band should be grasped with fine-pointed pliers at a point as remote from the joint as possible, so that they may absorb but little heat. (Fig. 63.) Flux should be applied, carried to the flame and *fused,* and a *very small* piece of solder then fluxed and placed immediately over the joint.

In soldering, it should be held in the flame so that each edge will be uniformly heated, because if either should receive a preponderance of heat the solder would become attached to it, and the addition of a second piece may be necessary. Any more solder than is required to make the joint is objectional because of the additional stiffness imparted to the band.

As it is desirable to begin with a high grade of solder to prevent subsequent re-fusing, and to admit of finishing with as high a karat as possible, all bands should usually be united with 22 karat solder, though 20 karat will answer the purpose.

For convenience and comfort, the pliers used to hold the work in the flame should possess a long handle and thin tapering points. (Fig. 64.) The addition of platinum points, which may be easily attached with any hard solder, increases their usefulness, as such pliers absorb less heat, retain their shape more permanently, and offer more resistance to the attachment of solder.


Fig. 64.

**Fitting.**

The fitting of the band may be made accurate, easy and devoid of discomfiture, in proportion to the relation it bears to the shape of the root and to the outline of its surrounding tissue, *before any attempt is made to adjust it.* The detail of requirements in this connection apply to any style of crown with a band, and are,

*First*—To conform the band to the general shape and outline of the root.

*Second*—To trim the edge which is to pass beneath the tissue to *closely follow* the cervical curvature of the process, and gingival festoon of the gum, so that it will come in contact *evenly* and *uniformly* at all points, before the final necessary pressure is applied.

*Third*—To *round* and *smooth* the edge so that no irritating influence will be offered in forcing it beneath the gum.

*Fourth*—For the purpose of convenience and of avoiding any confusion in *adjusting* and *readjusting;* because the usual convexity of roots at this point facilitates the adaptation of the stiffened portion of the band, and because of placing the soldered joint where it will be least conspicuous in case of subsequent discoloration, as well as being most easily accessible for reinforcement in the assemblage of bridgework, the joint in the band should *always* be placed at the *center* of the *lingual surface* of the root.

A neglect of any of these most essential features adds materially to the difficulties experienced in, and the possible discomfitures resultant from, the operation. In observing them the band should be gently placed over the projecting end of the root, and shaped with pliers until it is made to conform to its general outline, and any existing concavities or inequalities. Its surfaces should be made perpendicular, and the edge then carefully trimmed with curved pointed shears until it meets the gum line *evenly* at all points; and then nicely *rounded* from the outer surface with a fine half-round file, until blunt but smooth. This minimizes the pos-

sibilities of irritation, without obtaining any apreciable thinness of the gold which would be objectionable because of increasing the liabilities of stretching and irritation.

When these requirements have been complied with, the band should be placed upon the root, and gently pressed to place until the edge passes *just freely* beneath the tissue. For this purpose a small piece of wood of convenient size, with flat, smooth surfaces, is most useful; and if properly used greatly facilitates the operation, and obviates the *driving* of a band into place, which is entirely unnecessary, and even *brutal.*

In instances where a recession of the gingival border of the gum may have exposed the root beyond the normal outline at some point, such as is not infrequently found to present in the mesio-buccal and lingual roots of upper molars, an extension to the band may be indicated in preference to sacrificing it upon other surfaces sufficiently to admit of thus approaching the gum at this point. This may be best accomplished by first fitting the

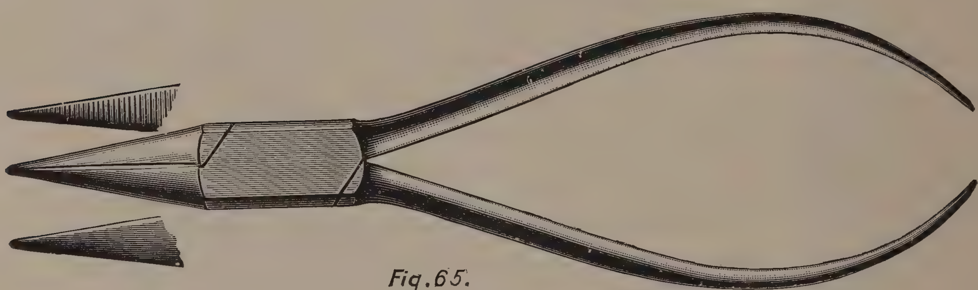


*Fig. 65.*

band accurately without regard to this extension, after which a small piece of pure gold plate may be soldered to the outer surface of the band, and then trimmed until this denuded portion of the root is covered. When the necessary burnishing has been completed, the adaptation may be sustained by re-enforcing the extension with a high grade of solder.

When the cervical adaptation has been completed, the occlusal edge should be trimmed to afford accommodation for the adjustment of a cusp of uniform and sufficient depth, and then filed smooth and contoured.

**Contouring.**

The entire artistic effect of the finished crown, as well as the prerequisites of contact and alignment, depends in a great measure upon the form and shape given to the occlusal end of the band, which can be *best* observed at this time.

By *contouring* is meant the reproduction of the natural form and outline of the tooth, and while this may be accomplished with solder,

after the cusps have been united, much time, energy and material can be saved, and far more artistic results obtained, by properly shaping the band itself.

Artistic results in this connection, however, are made possible only by a thorough knowledge of the angles, characteristics and general forms of the natural teeth, the outlines of which should be reproduced in this edge of the band. This may be done irrespective of the necessary shape of the cervical edge in its adaptation to the root, and without change of it.

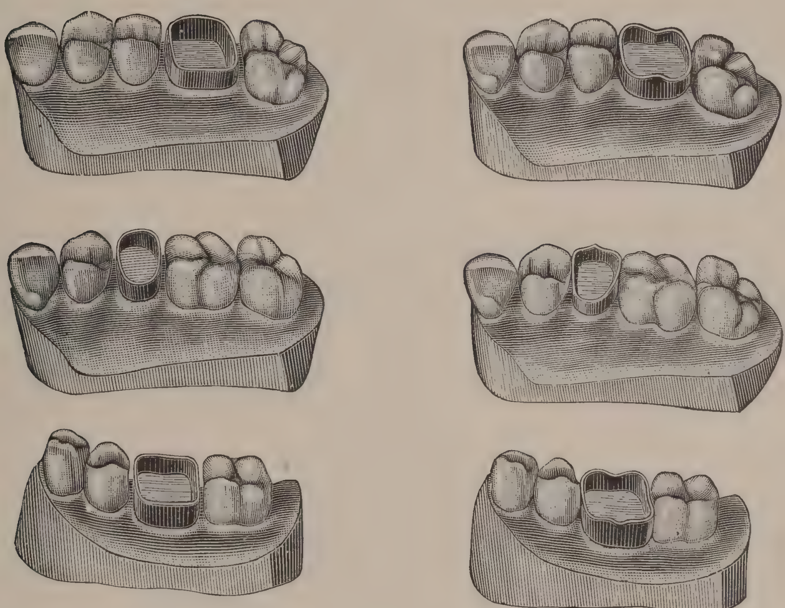


Fig. 66.

For contouring purposes various styles and designs of pliers are used, but as the shaping should be done upon the edge of the band, before the cusp is attached, all of the necessary and artistic results may be easily accomplished with pliers, the beaks of which are straight, tapering, and come closely together, with rounded edges. A design of the author's for this purpose and for universal use in crown work is illustrated in Fig. 65, and, while some of the numerous other designs may be found occasionally useful, these will meet the general requirements, when properly used.

The rounded edges and one smooth beak prevent defacing the gold, while the flat surfaces and one serrated beak, and the tapering form for stretching, adds to their general usefulness.

The average and typical requirements, and the results possible from a knowledge of the form and outline of the teeth, and a skilful manipulation of the pliers, are indicated before and after contouring the band in Fig. 66.

In instances where the diameter of the root after its preparation is larger than the proportionate dimensions of the occlusal surface, to secure a symmetrical alignment with the adjacent teeth it may become necessary to reduce the circumference of the occlusal edge of the band. This may be quite easily accomplished by cutting numerous slits around the approximal and lingual surfaces of the occlusal edge, and then drawing the points in and overlapping them until the circumference is sufficiently reduced. (Fig. 67.) These places may be afterwards filled in

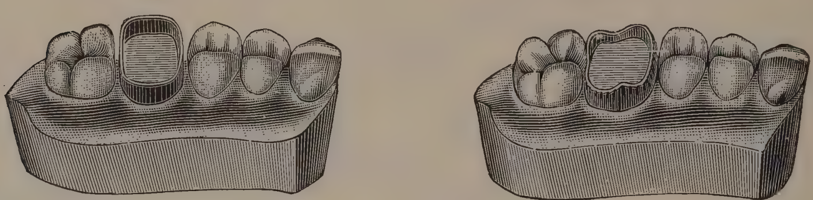


Fig. 67.

with solder until a smooth uninterrupted surface presents. Although the pliers previously mentioned may be used successfully, a very convenient form especially adapted to this purpose, and generally useful in reducing the size of either end of the band, when occasion requires, is illustrated in Fig. 68.

After securing the proper and desired contour, this edge should be filed smooth and even, the band then finally adjusted to the root, and the occluding bite and impression taken.

**Occluding Bite.** The interior of the band should be filled even with the edge with wax previous to taking the occluding bite. This facilitates the removal of the latter from the mouth and its final adjustment to the model.

The occluding bite should always be taken separately from the impression, and should *precede* it, because the imprint of the band is necessary to admit of its adjustment to the model with the band in place. Wax

is preferable for this purpose, because of the ease with which the relation and a good imprint of the teeth may be secured, and of its more easy and accurate adjustment to the model.

In obtaining it enough wax should be used to secure the imprint of at least two teeth on each side of the crown, whenever possible, and in the procedure it should be definitely ascertained that the teeth are in *direct* and *proper occlusion.*

The patient should then be instructed to firmly close the jaw, and press the wax against the lingual surfaces of the teeth with the tongue, when by compressing it closely to the buccal surfaces with the fingers a correct and well-defined bite is readily obtained.

**Impression.** The impression should *always* be taken with plaster, and, corresponding with the bite, should include two or more adjacent teeth, when present, on each side of the crown. This is necessary in order to prove and govern

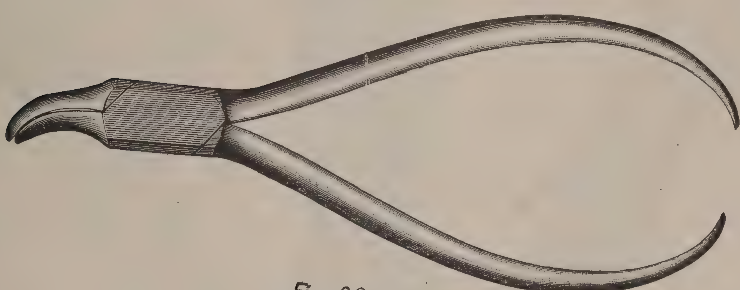


Fig. 68.

the occlusion when mounted upon the articulator. The use of plaster is essential for this purpose, because of the difficulty of, and uncertainty in readjusting the band to its accurate position in the impression, when any material is used which *draws* perceptibly in removing from the mouth. This may be done with a degree of absolute certainty when plaster is used.

Partial impression trays of convenient size for this purpose are illustrated in Fig. 69, two being adapted for the right and left sides, and one for universal use; the latter, of course, is the most generally useful. Because of the natural shape of the teeth, it will usually be found necessary to break the impression in removing it from the mouth, which is not objectionable if the parts are afterward accurately replaced. A

convenient tray, recently designed by Dr. E. L. Townsend to facilitate such procedure, includes a separable base composed of two smaller trays with the dividing line in the center. Upon the removal of the outer tray these remain in place, when they may be easily divided by the insertion of

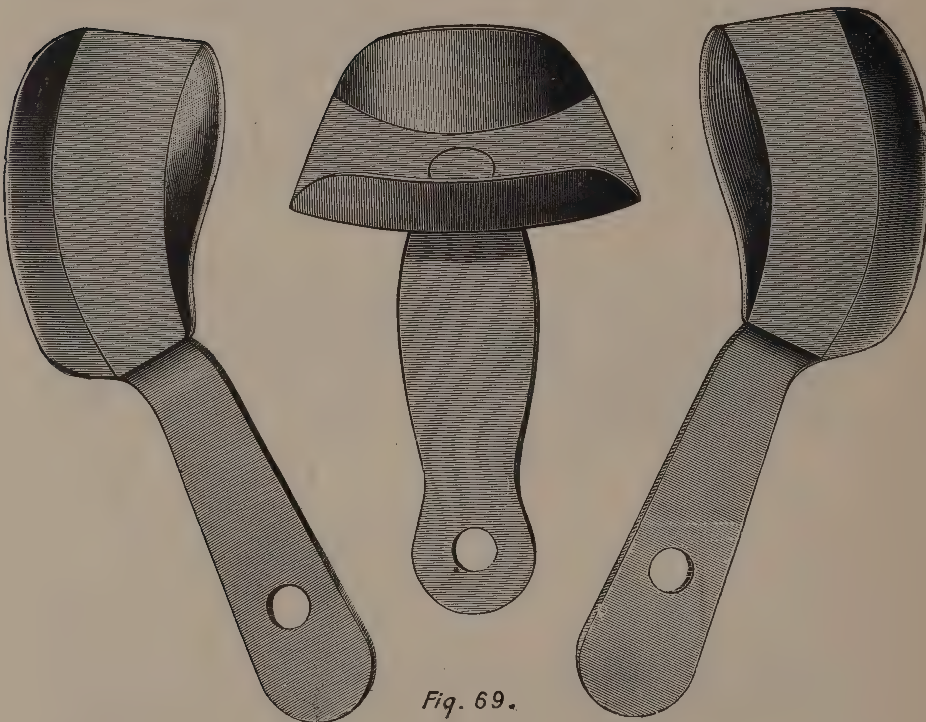


Fig. 69.

the blade of a small penknife, which separates the impression in two lateral halves. (Fig. 70.)

When the parts are accurately readjusted and their relation securely sustained with melted wax, the impression should be then varnished, filled, separated, the bite adjusted, and then mounted securely upon the articulator. For the purpose of facilitating the separation of the model

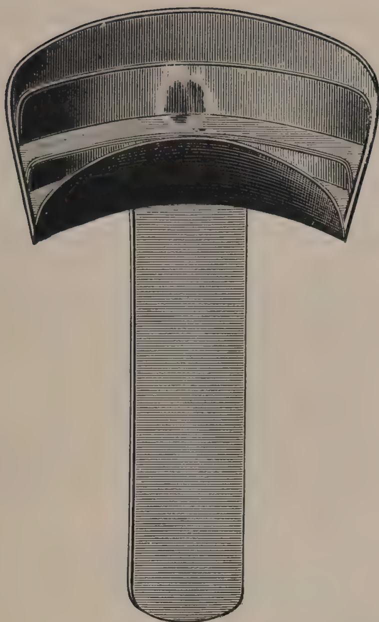


Fig. 70.

from the impression, the latter should be first coated with a *thin* solution of shellac in alcohol, and followed, after drying, with a coating of very thin sandarac, in alcohol. The former causes a line of demarcation of inestimable value in separating, and the latter gives a smooth, hard surface to the model.

**Articulators.** Because of the desirability of obtaining a degree of accuracy in articulation as well as occlusion, a reproduction of the lateral movements of the jaw, such as are made possible by the use of an anatomical articulator, is almost as essential in crown work as it is in the construction of artificial dentures.

For single crowns, however, such requirements, while always desirable, are not so essentially necessary, and in the absence of a design more conveniently adequate for the purpose, the ordinary crown articulator may answer. (Fig. 71.)

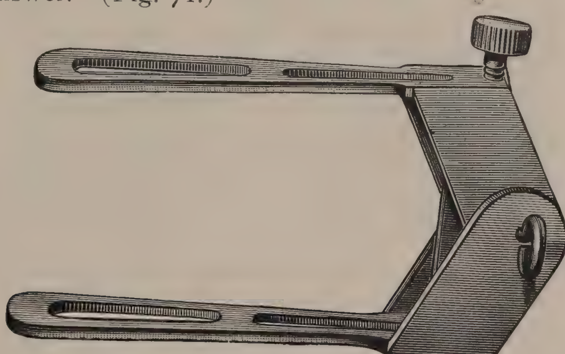


Fig. 71.

## Processes for Cusp Formation.

Of the various methods and systems for securing suitable cusp forms that will typify the natural teeth, and meet the requirements of articula-

tion and occlusion, but *one* general line of procedure offers absolute certainty and accuracy in all cases.

The importance of true occlusion, as has been previously emphasized, will be readily apparent, and is generally conceded, and yet throughout the entire evolution of methods for procuring it, a system of stereotyped typical dies has predominated. As the conditions presenting vary in proportion to the degree of the normal accuracy of occlusion, position of the root, and its relation to adjacent teeth, and the length and shape of band and depth of cusp required, the fallacy of expecting a ready-made form to closely fit and approximate the edge of a properly contoured band, and then articulate and occlude accurately with the opposing teeth, is manifest.

## Carved Cusp and Special Die Methods.

If these mechanical and artistic requirements are to be observed, the prerequisites of certainty and accuracy can be best obtained by forming

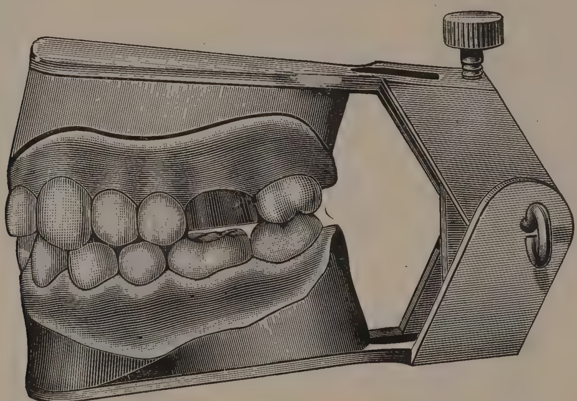


Fig. 72.

the cusp directly from an imprint of the opposing teeth, and in its proper relation to the band, as was originally suggested in primitive form by Dr. Norman W. Kingsley. While the detail of such a procedure may probably consume a little more time than some methods, *time* is not the only factor to be considered, except perhaps by *dental laboratories;* and the results will usually justify such an expenditure.

**Procedure**

When the models have been securely mounted upon the articulator (Fig. 72), all surfaces of the plaster in close proximity to the band should be varnished with a *thin* coating of collodion, sandarac or silex. The band

should now be filled with thin, well mixed plaster, into which the occusal surfaces of the opposing teeth are then imprinted by firmly closing the articulator. (Fig. 73.) The reproduction of adjacent teeth in the model serves to sustain and prove the proper occlusion. When this has become sufficiently crystallized, the articulator should be opened, and the band, with its plaster contents, detached from the model in such manner as to preserve its definite outline and relation. The surplus plaster around the

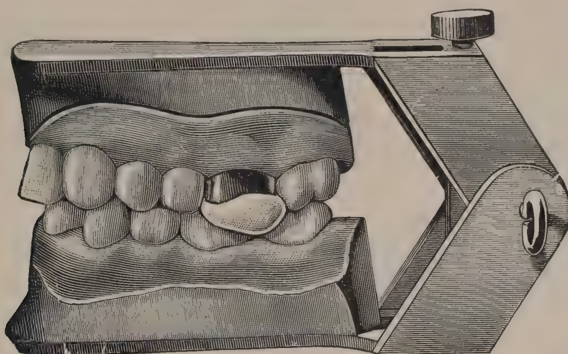


*Fig. 73.*

outer edge of the band should be removed with the sharp blade of a small penknife, which leaves the remaining contents somewhat crude and inartistic in outline, but accurate in occlusion. (Fig. 74.) An artistic effect, in proportion to the degree of skill possessed by the operator, may be obtained by inserting the grooves and pits of the typical outline

*Fig. 74.*

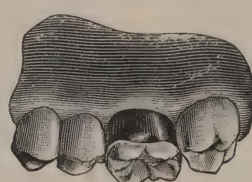


*Fig. 75.*

of the tooth, which may be done without perceptible change to the occlusion. In fact, the latter is thus improved because of the formation and separation of the cusps. (Fig. 75.)

While modeling compound, mouldine and wax are sometimes employed for the formation of cusps, the use of any of them is not so reliable as plaster, because of the tendency to flake in carving, or of the susceptibility to change form in the subsequent process of securing the mould for

the die, or for casting. In the process of carving, it is not altogether necessary that the *correct anatomical* outline of the tooth should be reproduced, but only to typify it sufficiently to designate the tooth it represents. This may be easily accomplished by inserting the grooves *deep* enough to separate the cusps, and typical enough in outline to distinguish the *right* from the *left,* and the *upper from the lower.* (Fig. 76.)

In the reproduction of the plaster cusp in gold, two methods of procedure are employed, by means of which plate gold may be conformed by swaging between dies, or a solid cusp produced by casting.

**Swaged Cusps.** Because of the possibilities for securing a more distinct and definite reproduction of the outline; of the time saved in adjusting and adapting the cusp to the band, and of securing adequate thickness of cusp by subsequent re-

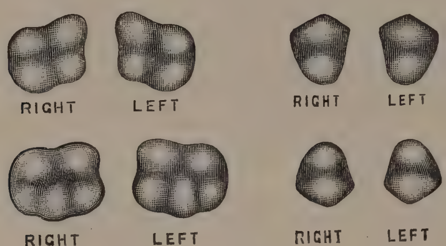



*Fig. 76.*

enforcement with solder, the swaged method is usually preferable.

For this procedure the *plaster cusp* should be trimmed away uniformly around its peripheral border, until the edge of the band is exposed. This reduction in size allows for the thickness of gold forming the cusp, and renders possible a *perfect approximation* of the edges of cusp and band. If not observed, the cusp will be as much larger than the band as its thickness, which will require the use of solder in securing a smooth surface in its subsequent attachment.

**Mould.** A moulding ring (Fig. 77) should be filled even and flush to its edges with mouldine, into the center of one surface of which the plaster cusp, after being dusted with lycopodium or soapstone, should be firmly imprinted *just deep enough* to secure the outline of the exposed edge of the band. The mouldine should be packed closely against the band around its circumference, and the band and plaster cusp removed from the

mould. This should be dusted with lycopodium and the dies secured.

**Dies.**

The most useful and convenient system of dies may be secured by placing a casting cup (Fig. 78), which has a small perforation through the center of the base, over the mould, and casting a cusp-button of pure tin or Watt's metal (Fig. 79). After cooling, the button should be detached from the cup with a small knife-blade, and placed upon a smooth surface of mould-

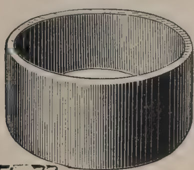


Fig. 77.

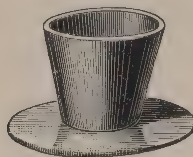


Fig. 78.

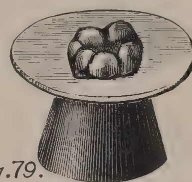


Fig. 79.

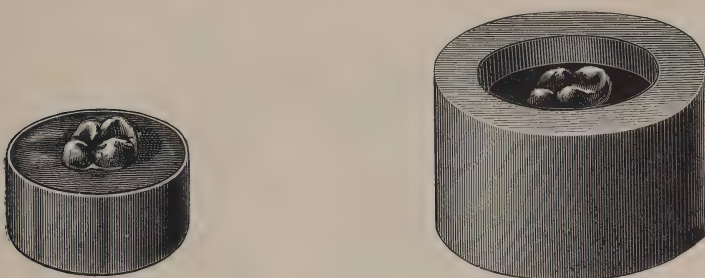


Fig. 80.

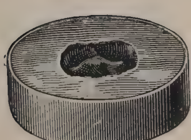


Fig. 81.

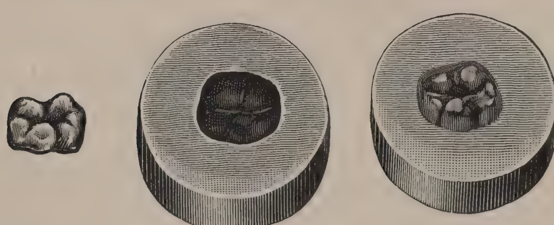


Fig. 82.

ine, in the moulding ring, then dusted freely with lycopodium, and the rubber ring adjusted for the purpose of securing the counter-die (Fig. 80), which is poured with fusible alloy.

A higher fusing metal than any of the fusible alloys is necessary for casting the cusp-button in order to preclude the probability of melting it in securing the counter-die.

In the process of forming the cusp with these dies (Fig. 81), the swaging should be done in the counter-die by the use of an ingot of lead, *or a large buckshot,* until closely adapted, after which the surplus gold should be cut away and the cusp-button used for the final swaging only, to bring out the finer lines. These cusp-buttons may be preserved and found useful wherever occasion admits of the use of ordinary and typical dies, such, for instance, as the absence of occluding and adjacent teeth.

Another method somewhat more simple is to secure the mould as indicated, and then adjust the rubber ring and pour the die of fusible alloy. The surface is then dusted with lycopodium or coated with a solution of whiting in alcohol, the rubber ring readjusted, and a counter-die of the same metal and dimensions secured. (Fig. 82.)

While this will answer the purpose, if the swaging is done in similar manner, the tendency of stretching and probability of tearing the gold

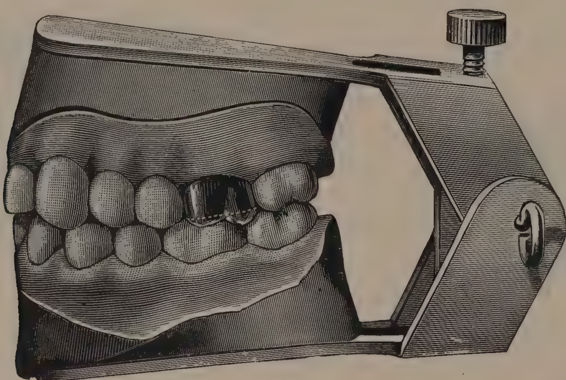


*Fig.83.*

will be increased, especially if the cusp is very deep, because of the difficulty of swaging and conforming gold, or any metal, to any given or desired shape between two surfaces of like and equal resistance, in which respect lies the advantage of the former method.

**Swaging.**

In the process of swaging, the surfaces of the dies should be *oiled* to facilitate the procedure, and prevent sticking. A convenient method of preventing the defacing of the gold is to stretch a piece of rubber dam over it before driving into the counter die. This also avoids any coating of the die metal from adhering to the surface of the gold. The chances of tearing the gold may be reduced to a minimum by first swaging a few layers of heavy tinfoil covered by the rubber dam. This slightly compresses the metals and affords space for the gold between the two surfaces of the dies, and it should first be carefully worked down into the counter die with

a small blunt-pointed piece of wood. The gold used should be of the same karat and color as the band, and of 28 gauge thickness, as it is to be subjected to considerable stretching. It should be cut somewhat larger than the diameter of the cusp to be formed, and frequently annealed during the process; and a round or disk-shaped piece of plate will yield more readily to the desired conformation between the dies, with less tendency to overlap at the angles; and all unnecessary surplus should be removed *before* the *final* swaging. Steady and uniform pressure, such as would result from the use of a press of adequate power, would be productive of better results, in the absence of which a *heavy* hammer and direct blow will answer.

**Adjusting Cusp.** When the swaging has been completed, the edge of cusp should be carefully trimmed down to the line marking its point of contact with the band, which should be outlined in the gold. This point can be approached with small curved crown shears, but the final trimming should be done with a fine flat-surface gold file, and may be best and more uniformly accomplished by holding the file steady and carrying the cusp backward and forward over its surface. The plaster cusp should then be removed from the band, and the latter adjusted to place on the articulator. After filling the interior of the band with wax to sustain the cusp, it should be consecutively trimmed and tried to place until the edges approximate evenly, and the desired occlusion is obtained and proven by the firm closure of the articulator. (Fig. 83.)

**Soldering Cusp.** The necessary re-enforcement of the cusp to fortify it against constant and continued attrition may be done with solder simultaneously with its attachment to the band, although no objection is offered to filling the cusp with solder previous to its

Fig. 84.

subsequent attachment if done with the same karat that would be indicated and used in the joint. During the process of soldering, the relation between cusp and band should be securely sustained. This can be best accomplished by the use of automatic pliers designed for the purpose as indicated in Fig. 84, the use of wire being objectionable for the same reasons previously mentioned in connection with soldering the band.

The parts should be treated to the acid bath, freely washed with water, and adjusted in the pliers. Flux should then be applied to the joint and fused, and the parts united with 22 or 20 karat solder. The necessary re-enforcement may be obtained with 18 karat solder. In case of a perforation of the gold as a result of swaging, the same should be first

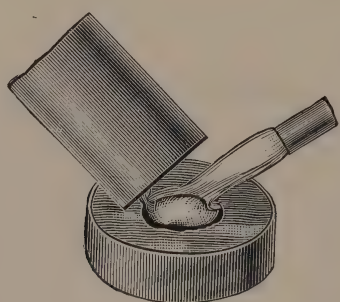


*Fig. 85.*

filled with foil, when no trouble will be experienced in covering it over or filling it in with solder.

**Finishing.** When the soldering has been completed, the crown should be again treated to the acid bath to dissolve remaining borax, then dressed down with carborundum stones and disks in the engine, and finally polished on the lathe.

**Solid Cast Cusps.** While no special or particular advantage is afforded by the formation of a solid or cast cusp, excepting that the presentation of a faulty or inaccurate occlusion may be remedied by grinding freely without exposing the solder, yet many prefer to pursue this method. When such procedure seems desirable, the plaster cusp, after carving, should be left *flush* and *continuous* with the *outside* edge of the band.

The moulding ring should be filled with mouldine, and the mould of the cusp secured on a line with the edge of the band. This should then

be placed over the Bunsen burner and allowed to remain until the mouldine becomes hard. Asbestos of adequate thickness to accommodate the depth of the cusp may also be used for the mould by saturating it with water until a suitable imprint of the plaster cusp can be made in it, after which it should be dried in the same manner. Scrap gold of sufficient quantity, sparingly fluxed, should be fused in the mould, and, when molten, may be easily cast by quickly pressing it into the matrix with a smooth surface of carbon or steel large enough to cover the entire area of the cusp. (Fig. 85.) The principal objection offered to this method is the time ordinarily required to trim and file the surface until a perfect approximation with the band, and the necessary requirements of occlusion are obtained.

## Cusp Formation without Models.

The same detail of procedure is applicable to the formation of cusps without the use of models or articulator. The results, however, while perhaps occasionally as artistic, are not so accurate, because no guide for

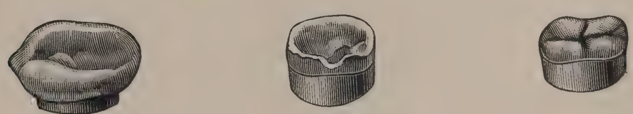


Fig. 86.

obtaining the correct length of cusps is present, and no opportunity is afforded for *proving* the articulation and occlusion in the final adjustment and attachment of the cusps to the band, unless it be done directly in the mouth.

When the employment of such a procedure may seem indicated, or when it may be desirable or necessary to complete the crown at a single sitting, the band in position on the root may be filled with a sufficient quantity of plaster, in the plastic state, or with modeling compound, and the teeth closed directly into it. After thoroughly hardening it should be removed, the surplus trimmed away even with the band, and the desired and typical shape and form then given it by carving, as is consecutively illustrated in Fig. 86, when the dies or mould may be obtained in the manner outlined, and the crown finished, as indicated.

## Ash's Crown Swaging Device.

Ash's crown swaging device, which consists of a cylinder and plunger, and a *soft* rubber or hydraulic pad, will be found quite useful

for swaged cusps, because of eliminating the necessity for the use of any counter-die, or of swaging between two surfaces of metal, and, by preventing any rebound, displacement or defacing of the gold during the process.

In its use the mould from which the die is secured must be obtained in a moulding ring of suitable dimensions, to render it of a size corresponding to the interior diameter of the cylinder. These are included in an outfit suggested by Dr. E. G. Christiansen, of Dremmen, Norway, and manufactured by C. Ash & Sons.

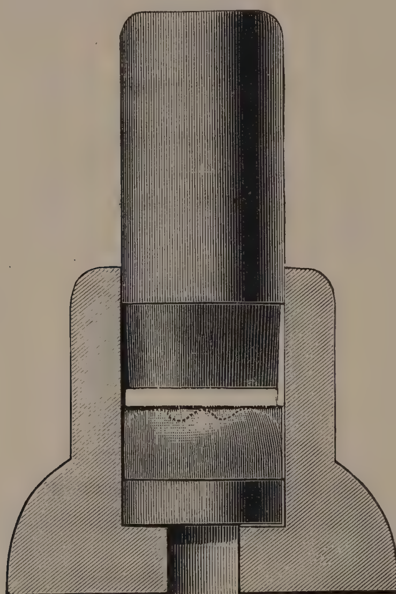


*Fig. 87.*

When the die has been secured with fusible alloy it should be placed in the cylinder, the gold annealed and placed in position, and the soft rubber or hydraulic pad then inserted.

The plunger is then adjusted, and, upon being driven into the cylinder, results in the swaging being easily and quickly accomplished, without danger of tearing or defacing the gold.

If the cusp-button method of dies has been employed, and the button afterward used only to bring out the finer and more definite lines, the swaging may be done in the counter die in the same manner (Fig. 87).

## Die and Die-Plate Methods.

The advent of the die and the die-plate systems was, primarily, the outcome of a desire for obtaining more natural and artistic results in the process of cusp-formation than was then possible by pursuing the primitive method. Originally, efforts in this line were confined to soldering a flat surface of gold to the band, and then building the cusps at various points upon this surface with small globules of scrap gold, or pieces of triangular platino-iridium wire, attached with solder; or with solder alone, and subsequently grinding to the desired form and occlusion.

While many of these somewhat crude, inaccurate and inartistic efforts were successful from the standpoint of serviceability and usefulness, the introduction of dies soon followed. These were designed to serve as a means of securing more artistic results, and as a time-saving procedure.

**Individual Dies.** The first productions in this line were individual dies, obtained directly from the natural teeth. For this purpose suitable extracted teeth were selected, and mounted in a base of plaster. This was then trimmed to favorable shape for securing a mould in sand, from which a casting was made of zinc.

Plate gold was then swaged to conform with the outlines of the natural cusps by driving the die into a smooth surface of lead, or an old discarded counter-die.

This method was productive of so great a degree of improvement over the former procedure as to subsequently induce the supply-houses to manufacture these dies in sets of various numbers, and made of brass in order to be more permanent and indestructible (Fig. 88).

Fig. 88.

**Die-Plates.** Because of the immediate necessity for a suitable counter-die, and of the advantage of combining a larger variety of cusp-forms into more convenient and compact order, the introduction of the die-plate was a natural sequence.

These comprise various numbers of cusp-moulds in a *brass* or *steel* casting. In their use the swaging is easily and quickly accomplished by driving the disk of gold into the mould selected to best approach the requirements, with an ingot of lead or alloy of lead and tin. Ingots for the purpose may be previously cast in any quantity, and of adequate and convenient sizes by the use of a *hub-mould* designed for, and usually accompanying, the die-plate (Fig. 89). Ordinary buckshot, however, are easy

to procure, and, if of suitable size, will answer the purpose nicely. The steel plates may also be thus employed, or may be used to produce solid cusps by driving an ingot of scrap gold into the mould selected.

While these plates are still in common use their value and range of application increases in proportion to the number and variety of cusp-forms contained, and their limitations, of course, decrease in inverse ratio.

**Application.**

In their use the mould should be selected which best represents the individual tooth to be crowned, and meets or approaches the size of the band. The requirements of occlusion must be secured in the fitting and adjustment of the cusps to the band, which can only be observed, of course, after swaging the cusps.

**Adjusting with Models.**

With cusps formed by *any* die-plate system or method the best and most accurate relation can be secured with models mounted upon the articulator. Opportunity is thus afforded for trimming the band

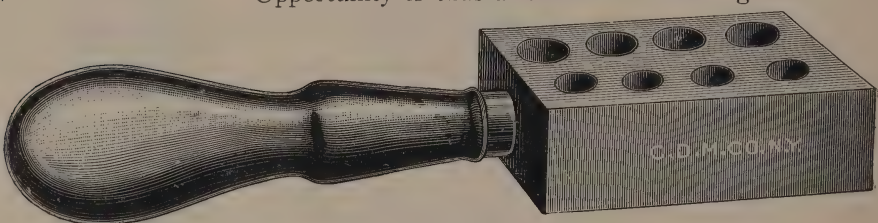



Fig. 89.

or the cusps, until their approximation admits of a favorable occlusion, which can be noted upon the lingual as well as the buccal surfaces.

More perfect occlusion may often be obtained by depressing the cusps with a blunt instrument, or piece of wood; or, if necessary, by building up, wherever indicated, with a *high grade* of solder. Small globules of scrap gold or pieces of gold or platinum wire facilitate such procedure by affording a guide as to the desired formation and location, and by requiring the control of less solder in their attachment.

When the requirements of occlusion have been thus observed, an effort should be made to closely approximate the edges of cusps and band. This may be done by adjusting the one to the other with pliers, if care be exercised so as not to distort the shape of the band and destroy its contact and alignment. Any necessary filling in or subsequent contouring may be done with solder in the final attachment. Where a considerable space exists between the two portions, the process of soldering is facilitated by burnishing a piece of thin pure gold plate, or packing foil gold into such spaces.

**Adjusting without Models.** In emergencies, or where it may seem desirable to complete the crown without models, and secure the adjustment in the mouth, the fitting may be facilitated by filling the interior of the band with wax to temporarily sustain the cusps during the process. When the parts have been approximated, a more perfect occlusion may often be obtained by tacking the cusps to the band at one point with a very small bit of solder, and then replacing the crown and having the opposing teeth closed firmly into it, after which the soldering may be completed, and the necessary reinforcement given. If the requirements are particularly difficult, the process may be further facilitated by swaging the cusps of 30 gauge pure gold. This is so much more yielding and will offer so little resistance to the closure of the teeth into firm occlusion, as to insure moderately accurate results, but such cusps should be attached with a very high grade of solder, as the extreme softness of the gold will soon result in its exposure. This procedure is equally applicable, of course, to the adjustment of cusps formed by any system or method employed.

## Hollingsworth System.

The great variation in the size, shape and depth of cusps necessary to meet or approach the requirements of this style of crown construction, and the previous absence of any system, or definite detail in the work, resulted in the introduction of the Hollingsworth System, devised by Dr. J. G. Hollingsworth.

This was the first system embracing a detailed line of procedure in the construction of gold crowns, and because of including a large variety and selection of typical forms, of its simplicity, and of being so great an improvement over former methods, it is much used.

It comprises about two hundred typical occlusal forms in the shape of cusp-buttons, and a good selection of moulds of the buccal surfaces of bicuspids and molars, and of the labial and lingual surfaces of the anterior teeth.

Those for the buccal surfaces of bicuspids and molars are designed for the purpose of securing a more artistic shape in these surfaces of the band by swaging, or for gold reproductions of the entire tooth. For the former purpose, however, such procedure by any system is unnecessary, because of the time consumed, and of the possibilities for otherwise, and more quickly securing a proper and equally artistic shape. While such moulds may often be found useful for obtaining all gold dummies for bridge construction, those for the anterior teeth are practically useless, because of the limited indications for the application of such crowns.

The variety, form and convenient shape of the cusp-buttons, how-

ever, affords for them a more or less extensive range of application and usefulness. They are made of a metal which is moderately indestructible, and are used only for the purpose of forming the die for the subsequent conformation of the gold by swaging, or for securing the mould in asbestos for the purpose of obtaining solid cast cusps, as previously indicated.

The convenient size of the cusp-buttons possesses the advantage of facilitating the selection of the one most favorable to meet the requirements, which may be accomplished by trying to place upon the band, on the articulator, or in the mouth.

Aside from the forms, the system consists of a steel moulding plate and suitable rubber moulding rings.

**Application.** When the cusp-button which *best* represents the tooth, and meets the requirements of occlusion and approximation with the edge of band, has been selected, it should be deposited upon the moulding plate, and the rubber ring placed around it. Fusible alloy should be then melted and poured into the ring. In pouring, it should be directed immediately upon the center of the cusp-button, in order to prevent an imperfect die, or one not entirely surrounded with metal.

When the fusible alloy has crystallized, it should be cooled by dipping into water, and the rubber ring then detached. The cusp-button may be then easily separated by gently tapping, and replaced in the tray, and the die is ready for the swaging of the gold. This is accomplished in the manner indicated, by the use of a buckshot, or ingot of lead, driven to place with a swaging hammer, after which the surplus may be trimmed away, and the cusps finally adjusted to proper relation with the band and occlusion, and then soldered.

The use of these cusp-buttons offers the additional advantage of affording opportunity for modifying or improving the occlusion when indicated, by building the cusps up with mouldine at the desired points, and to the desired depth, before pouring the die. Also, in cases where the band may be so short as to require a deeper cusp, this may be easily secured by raising the cusp-button on the moulding plate with a base of mouldine of sufficient thickness to make up the deficiency in depth, and trimmed to closely follow the outline, before pouring the die.

## Millett's System.

One of the most modern inventions in die-plates, and processes of swaging, and one possessing some new and good features, has been recently introduced in Millett's System.

This consists of a large die-plate comprising about four hundred raised moulds of cusp-forms, and buccal and labial surfaces, systemati-

cally arranged in sizes, and for each side of the mouth, and the necessary apparatus for swaging.

While the forms are similar in size and shape to those of the Hollingsworth System, the die-plate offers a greater range of application in a larger variety for selection, and the advantage of each one being an integral part of the plate, which overcomes the possibility of the disarrangement or loss of any of them.

This, together with the method of securing the die, and the process of swaging, without doubt affords greater simplicity and quicker results, but the important feature of not being able to adjust the cusp-forms to position on the band, as an aid in their proper selection, is a disadvantage.

The apparatus for swaging includes a cylinder and plunger, and a bed-plate and soft rubber block, which are similar to Ash's crown swaging outfit.

**Application.** The bed-plate is designed for the purpose of holding a sufficient quantity of ordinary sealing-wax to secure a die of any of the individual moulds, and fits accurately in the cylinder.

The sealing-wax contained in the bed-plate is softened by passing through a flame, and then pressed firmly over the form selected to be duplicated in gold, and which is *calculated* to be the nearest approach to the requirements.

This gives an accurate impression of the form, in the wax, which, after chilling in cold water, is sufficiently hard to answer the purpose of a die.

This is placed in the cylinder, the gold annealed and placed on top of it, the soft rubber block inserted, the plunger placed over all, and the swaging accomplished by driving the plunger into the cylinder with a moderately heavy swaging hammer.

In cases where a deeper cusp-form is desired, or necessary, a rim of warm sealing-wax may be moulded around the edge of the imprint until sufficient increase of depth is obtained, before swaging. Where a more shallow reproduction is indicated, the sealing-wax may be trimmed or pared down accordingly; or, if the summits of one or more of the individual points or cusps need to be made more pronounced, the die may be deepened at such points with a sharp bur or suitably shaped cutting instrument.

## Lowry System.

This system, devised by Dr. H. S. Lowry, departs from other methods where moulds are used, and, like the original die-plates, comprises the actual dies to be used in the process of swaging.

The improvement lies in the more extensive selection, and the supplemental *trial caps* which represent the exact size and formation of the dies.

The dies are individual in character, made of a practically indestructible metal, and each one is numbered. The trial caps are numbered corresponding with the dies of which they are counterparts, and are provided with a projecting stem, which facilities holding and handling them in their adjustment to the band, in the process of selecting the one best suited to the requirements.

The system includes a moderately good selection of about sixty dies of cusp-forms; and a smaller number of the buccal surfaces of bicuspids and molars, and the labial surfaces of the anterior teeth, with corresponding complement dies, together with a "stamper" for swaging, and soldering pliers for general use.

**Application.** The trial caps are adjusted to position on the band, until a selection is made of the one which best meets the requirements. The number of this is noted, and the corresponding die selected. The surface of the die should then be slightly oiled, and the gold cut, annealed, and placed over it, and then adjusted to position in the "stamper." A buckshot or piece of lead of suitable proportions should then be placed upon the gold, and the plunger of the "stamper" brought in contact.

The plunger is held quite securely in any position by means of frictional contact, which facilitates the swaging in preventing the rebounding of the die, or the slipping or moving of the gold or lead during the process of driving it down by the use of a swaging hammer.

A special die, containing two depressions of different sizes, is provided for improving the occlusion when indicated, by lengthening or deepening the cusps at any desired point. After the cusps have been swaged, the point to be raised or deepened should be placed over the hole, and further swaged to the necessary extent by the use of a blunt piece of wood of suitable size.

## Baird System.

Another recent device in this line is the system and method designed by Dr. W. H. Baird.

This consists of a heavy pair of swaging pliers, with parallel jaws, one of which is grooved to admit of slides which support the dies.

The dies are raised and individual in character, made of a comparatively indestructible metal, and include about two hundred and fifty moderately good forms. These comprise a good selection of *cusp-forms*, and

a proportionate number of the buccal surfaces of bicuspids and molars, and the labial and lingual surfaces of the anterior teeth.

**Application.** When the selection of the form calculated to best meet the requirements has been made, it is then placed in position on the slide, and the latter adjusted to the grooves in the pliers.

The gold is then annealed, placed upon the die, and covered with a pad of soft rubber, or piece of sheet lead of adequate thickness (about 3-16 of an inch), and dimensions, to serve as a counter-die. The pliers are then closed and held together with sufficient firmness to prevent any rebound during the process of swaging, which is accomplished with a hammer.

The flat base to each die precludes any opportunity for accurately adjusting to the band, in making the selection; and the system affords no provision for altering the cusp reproductions to more perfectly meet the requirements of occlusion, depending upon the variety and general application of the dies for this purpose.

## Seamless Method.

The seamless method comprises forming the entire crown with one piece of gold, by swaging, and, while many *systems* for this particular style of construction have been devised, and are used, a close observation of the relative advantages and disadvantages as compared with the sectional method fails to afford any real or practical evidences of special merit in this process.

It is claimed by those using and advocating this method that a closer reproduction of the natural tooth form is possible, and that greater opportunities for more pronounced contouring are afforded, from which assertions it is deduced that more artistic results may be obtained.

As such results *from any method of procedure,* however, are *equally* dependent upon the skill, ability and conscientious efforts of the operator, and, as the presence of a joint between cusp and band is in no way objectionable if the prerequisites previously mentioned have been observed, any actual or *practical* foundation for such a claim is scarcely apparent.

If it were still necessary to depend upon a *limited* selection of cusp forms, which were difficult to adapt to the average properly contoured band without the use of considerable solder and much filling in, some advantage might be possessed by a method which would afford a smooth continuous crown, but, in view of the possibilities already outlined in this connection, the real value of the seamless method will doubtless always remain more appreciable to the "dental laboratories," and others commercially interested, than to the average practitioner of ordinary skill.

**Advantages.**

A summary of the possible advantages of this method presents but two special features: First, the opportunities for obtaining contour, and, second, the absence of a joint or seam of solder at any point.

The *first* feature needs no consideration, because, as has been previously asserted, the possibilities of, and opportunities for, contouring, are not entirely dependent upon the process employed, and in no way exceed those offered by the sectional method in so far as the actual requirements are concerned.

In considering the *second* feature, the absence of a joint or seam of solder may be proclaimed as an advantage in *three* instances of detail. First, in eliminating the possibilities of the subsequent discoloration of the solder in the joint, when subjected to the action of the secretions. Second, in the construction of a platinum crown which is to serve as an abutment for porcelain bridgework. Third, in the construction of a gold crown for the bicuspids where a porcelain facing is to be subsequently inserted.

In the *first* instance, if the edges to be united are *closely fitted* and *approximated,* the quantity of solder in the joint is so infinitesimal that if a high grade of similar color be used, and the crown then well finished and polished, no opportunity will be offered for any subsequent discoloration; hence, no special advantage is apparent.

In the *second* instance the same advantage may be readily obtained by permanently overlapping the edges of the band in making the joint, and closely approximating the edges of cusp and band, and then using *platinum solder* in their union. This will preclude the re-fusing or unsoldering of the parts in the furnace during the process of fusing the porcelain; and the additional thickness of platinum which may be used when the sectional method is employed adds materially to the necessary strength which such a crown must possess in that particular portion of it *which surrounds the root.*

In the *third* instance the advantage is perhaps *least* imaginary, but if the joints of the sectional crown intended for such a purpose are made as has been indicated, the subsequent attachment of the facing with a lower grade of solder may be done without danger of re-fusing them. This may be also further prevented, if any doubt exists, by previously coating the solder in such joints with a solution of whiting in water or alcohol before attaching the facing.

**Disadvantages.**

The features of this style of construction which are of a more or less pronounced disadvantage, in a general way, lie in a consideration of the essentials of time, strength and accuracy of adaptation.

**Time.** The detail being more circuitous, a greater length of time is necessarily consumed in the process. If better results by this method than by any other were possible, this should not necessarily be a consideration, but it becomes a matter of much concern when equally good results may be obtained by another method in *less* time.

**Strength.** The fact that a much thinner gauge of metal must be used to begin with, and that it must then be subjected to considerable stretching, is conspicuously a disadvantage, because of the extreme thinness and consequent weakness of the finished crown. While sufficient re-enforcement of the occlusal portion may be afterward made, the band, where equal and uniform *strength* is usually required, must remain inherently weak, or be stiffened at the expense either of the root or of the contour.

**Adaptation.** As a degree of accuracy *must* be insured in the process, the adaptation to the root of a primary or temporary band is necessary. This, however, in one particular is a disadvantage, because, irrespective of however accurate *it* may be, each subsequent reproduction of a given form is less accurate than the original, unless they may be stamped in indestructible and unyielding dies, which qualities are not possessed by fusible alloys, such as are used for the dies in this work.

## Detail of Construction.

While there are many and varied methods of detail for the construction of seamless crowns, but *one* general line of procedure will be found to give results which are sufficiently reliable to insure an approach to the necessary degree of accuracy.

This constitutes taking a measurement of the root, after its preparation, and making and fitting a *primary* band, the exact shape and conformation of which is then subsequently reproduced in the finished crown.

**Primary Band.** The primary band may be made, preferably, of 32 gauge copper, cut to ordinary width, the exact length of the measurement, with straight edges, and soldered as usual. Or a seamless band may be made by selecting the drawing punch over which the circular measurement will fit most closely, and then drawing a blank down to this same size. By then punching out the top, a seamless band results, which approximates the size of the root as closely as the measurement fitted the punch. Those preferring the latter usually have a selection of these blanks already drawn to various sizes, which is an economy of time.

When the band has been made, it should be trimmed and fitted to the

root with the same degree of care and precision as though it were intended for permanent use. It should then be cut away upon the *buccal* and *lingual* surfaces until but a narrow rim remains, allowing the approximal surfaces to remain sufficiently wide to be closely adapted to the adjacent teeth. (Fig. 90.) By so shaping it, a perfect restoration of the contact points may be made, and increased opportunity is afforded for forming, shaping, modifying or exaggerating the buccal and lingual surfaces as may be desired.

**Bite and Impression.** When the fitting and trimming has been completed, the bite and impression should be taken. While this is often done at one and the same time, with wax or modeling compound, a *separate* bite in wax, and impression in *plaster* is preferable, and safer, because of the uncertainty of *replacing* the band in its *exact* and *proper* position in the former materials.

When these have been secured, and the band accurately replaced in position in the impression, the model should be obtained, the bite adjusted

Fig. 90.

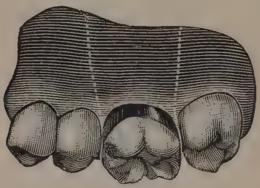


Fig. 91.

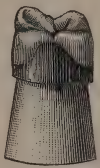


Fig. 92.

to it, and both securely mounted upon the articulator. After separating, the surfaces of the adjacent and occluding teeth should be varnished and the band and space filled with thin, well-mixed plaster, and the articulator firmly closed.

This portion of the procedure and the subsequent carving and shaping of the plaster is almost identical with the detail previously outlined in carving cusps, and all of the necessary artistic work must, of course, be done at this stage, because the permanent crown will be a close reproduction of this model.

The only difference in the detail is that the form and alignment of buccal and lingual surfaces is obtained by shaping the plaster, instead of contouring the wider band, and that it should be done *without* detaching the band from the model, and also that the plaster should be left flush, even and continuous with the band, instead of being trimmed to expose its edge as for a swaged cusp.

**Preparing Models.** When the necessary carving has been completed, the model should be detached from the articulator, and trimmed down until only enough remains to form a base for the crown, as indicated in Fig. 91.

This plaster base is then trimmed, so as to be favorable for, and facilitate handling during the process of securing the die, and to give

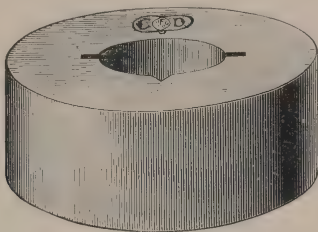
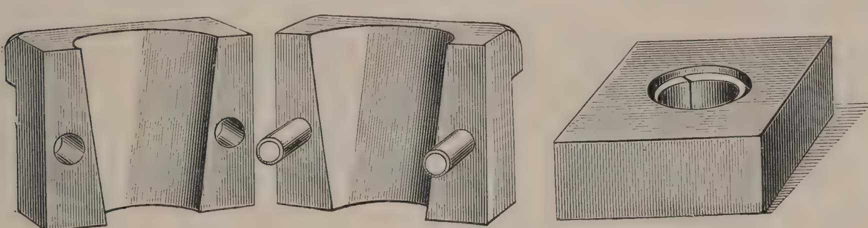


*Fig. 93.*
(Half Size)

adequate depth or body to the latter. The plaster base immediately adjacent to the *cervical* portion of the band should be cut away sufficiently to expose the full thickness of the edge, which thus stands out in the die and indicates the outline, after swaging, to which the finished crown should be trimmed. (Fig. 92.)

**Casting Flasks.** Various designs of casting flasks have been devised for the purpose of serving as a matrix in securing the dies with fusible alloy. Much similarity of principle exists between them all, and the one which is a part of the



A *Fig. 94.* B

Seamless Crown Outfit, manufactured by the Consolidated Dental Manufacturing Company (Fig. 93), is simple and conveniently adequate for such purposes; though those designed by Dr. W. H. Trueman (Fig. 94a) (which must be held in a vise while swaging), and the Berry Dental Manufacturing Company (Fig. 94b), will be found to favorably meet the requirements.

**Dies.**

In securing the die, the plaster model containing the crown should be *thoroughly dried* to prevent any bubbling of the metal, dusted with lycopodium, and then placed on a smooth level surface of steel or mouldine, so as to rest firmly and sustain a perpendicular position and the casting flask placed over and around it.

A piece of thin cardboard should be adjusted to the grooves in each side of the flask, and trimmed to *follow the outline* of the model (Fig. 95). These are intended to facilitate the subsequent separation of the die into two lateral halves, but should not come in contact with the model at any point.

The flask should then be filled with fusible alloy, poured when in the

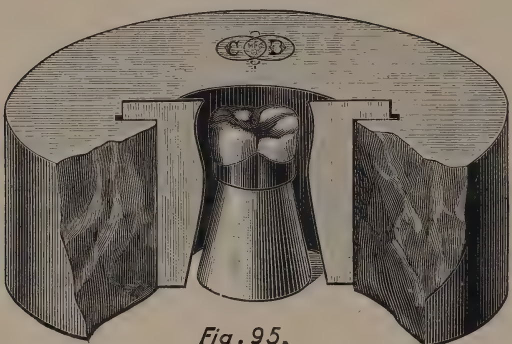


*Fig. 95.*

*plastic* state, in order to insure a smooth, well-defined casting, and to facilitate the separation of the crown from it.

Another method is to first fill the flask with the molten alloy, after adjusting the cardboard, and then firmly force the model into the center of the metal just before the process of crystallization takes place, holding it in position until it has thoroughly hardened. If done just at the right moment, this method is productive of good results, but the procedure is somewhat more uncertain than the former.

After chilling the metal with cold water, it should be removed from the flask and the cardboard detached. By inserting a chisel into one of the grooves thus formed, and striking it a moderate blow, the die may be easily separated into two parts. (Fig. 96.) The model is now removed from the die, and the parts may be readjusted to proper relation, and replaced in the flask, which possesses a guiding notch to insure proper read-

justment, and which holds them securely together during the process of swaging the crown.

**Forming Blanks.** The seamless blank, or cartridge, which is to be conformed to the desired outline of the permanent crown, by swaging, should now be formed.

For this purposes all of the "Systems" or "Outfits" contain or include

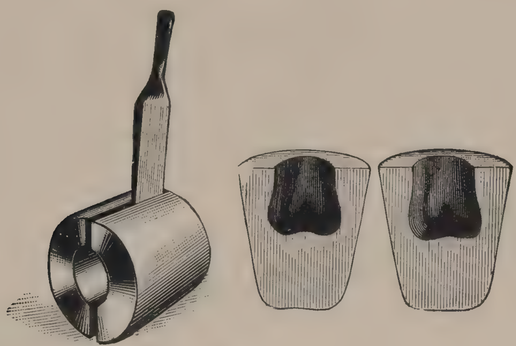


*Fig. 96.*

a steel plate with perforations, the diameters of which range consecutively from the largest to the smallest useful sizes, with a set of steel punches correspondingly graded.

A disk of 22 karat gold, not thicker than 30, or thinner than 32 gauge, should be procured. These are prepared by the supply houses in various sizes. The two sizes most convenient for molars and bicuspids are illus-

*Fig. 97.*

trated in Fig. 97 and may be symmetrically cut from plate by using an accompanying copper disk, or the end of a drawing punch as a guide.

These disks are formed into the blank by driving them through the holes in the plate with the drawing punches, beginning with the largest size and passing through *each* consecutive perforation until the blank is reduced to a size which will admit of its being gently forced into the die.

If a seamless *primary band* has been used, the size of the drawing punch last used in its formation will, of course, indicate the size of the blank required for the crown, and the size or number should be designated or remembered.

The gold should be *annealed often* during the process to prevent tearing, and slightly oiling the end of the punches and the interior of the perforations will be found advantageous in facilitating the drawing and preventing the blank from sticking to the former.

The *drawing press* designed for this purpose by Dr. W. M. Sharp may be found useful. It can be securely fastened to the bench and the blank is formed by means of a screwpress instead of driving, which re-

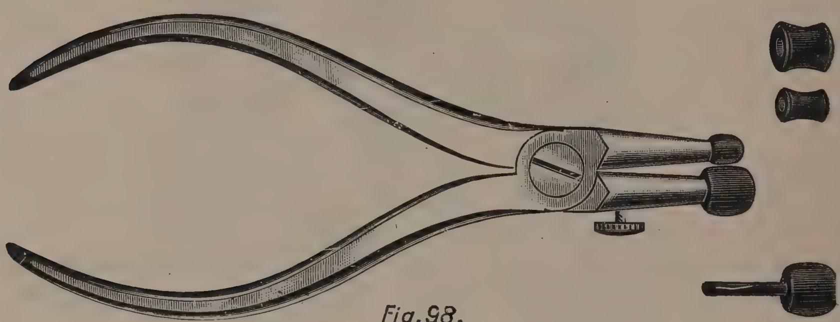


Fig. 98.

sults in its being drawn more evenly and uniformly than by intermittent blows.

**Swaging.** When the blank has been formed to the desired size, it should be cleaned in the acid bath, and then annealed. The surface of the die should be oiled and the blank *gently* forced well down into place with a blunt piece of soft wood of suitable size, and a small hammer.

Any excessive surplus of band may be previously trimmed away to facilitate swaging, but care should be exercised not to trim too much.

The interior of the blank should be filled with a substance which will spread readily and evenly when pressure is applied, but which may be *easily removed* at any time during the process.

*Oiled* birdshot, cornmeal, pumice stone, small cubes of modeling compound, base-plate gutta percha cut into small pieces, pledgets of moistened cotton, or cotton previously saturated with melted wax, stiff putty mixed with soapstone and tin foil rolled into small globules are used.

The swaging is then accomplished by driving a blunt piece of wood, or the end of a drawing punch a few sizes smaller, into the blank thus

filled. If necessary, the gold may be removed and annealed several times, though once after starting and *during* the process is all that is usually required.

**Adapting and Re-enforcing.** When the swaging has been completed, the surplus should be trimmed away to closely follow the cervical outline indicated in the band, and the crown *slightly* heated and subjected to the acid bath, when it may be re-enforced with a high karat of solder or a lower karat of plate gold, *rolled thin*, and finished.

If the finished crown should be too large, it may be reduced with pliers before re-enforcing, or if *much* too large as a result of compressing the walls of the die during the process of swaging, it may be first cut in two lateral halves, left in the die, and another crown swaged inside of it; or if too small, which is rarely the case, it may be stretched sufficiently with pliers. Where some expanding or compressing of the bulbous portion may be indicated in order to improve the contact with adjacent teeth, the rotary point contouring pliers designed by Dr. C. W. Miller will be found useful (Fig. 98).

While many of the various "systems" provide means for securing the *model* from a selection of typical forms of approximate sizes, from which the dies are made; and for securing the outline of the occlusal surface by subsequently swaging in a typical die-plate, or other similar manner, the possible results obtained from such methods do not merit consideration because of being but little, if any, more accurate than ordinary *ready-made* crowns.

## Reverse Process.

In the preceding process it will be noted that in the detail of swaging, the blank is conformed to the outline of a *mould* or *die* of the original model, by *expanding* or stretching it. This is termed the "*inside-out*" method, and, while it is perhaps most generally used, the extreme thinness of the finished crown, augmented by the necessity of beginning with so thin a gauge, very consistently occasions the objectionable features already intimated in this connection.

As a means of overcoming such objections, and obtaining increased thickness and strength, the *reverse* or "*outside-in*" process of swaging has been devised.

In this method the blank is conformed by being *compressed* over a metal reproduction of the original model, instead of being *expanded* to meet the walls of a mould *of it*.

**Advantages.** While the process of swaging is perhaps more difficult to accomplish, the results are advantageous in being productive of a *heavier* and more *uniform* thickness of gold in the finished crown, and of greatly diminishing, if not entirely overcoming, the probability of tearing it.

**Disadvantages.** The result obtained by swaging the gold over the outside dimensions of a metal reproduction of the original and desired form, would seem to be objectionable in that the crown so conformed must be somewhat larger than the model. This, together with the tendency of the gold to overlap and knuckle here and there, during the swaging, are logical disadvantages, unless means are observed for overcoming them.

While the overlapping and knuckling may be easily avoided by careful manipulation of the gold during the process, the difference in size occasioned by the thickness of gold can be overcome *only* by using *force*

Fig 99

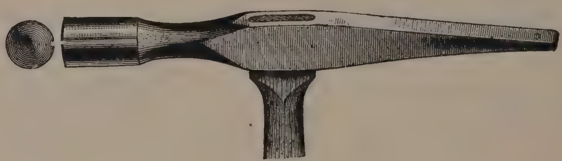


Fig 100

enough in swaging to so compress the die by the impact as to compensate for this thickness, or, by *removing* the primary band just previous to reproducing the metal model.

In view of the characteristics of the lower melting fusible alloys which are necessarily used, and of the thinness of the gold after being drawn down to the required size blank, it is possible that fairly accurate results may be obtained by depending upon the compression of the metal model from the force and impact of swaging; yet as this is more or less uncertain, the removal of the band is the preferable procedure and will afford the most positive and accurate results.

**Procedure.** As the *variation* between this and the preceding method pertains only to the manner of securing the dies, and to the process of swaging, the procedure up to the point of obtaining the model is identical with that already outlined.

**Original Model.** When the crown has been removed from the articulator, and its plaster base trimmed to the required form as previously indicated in Fig. 92, it should then be *reproduced* in fusible alloy, instead of obtaining metal dies of it in the form of a mould.

If the band is to be removed from the model, the plaster base should be trimmed away sufficiently deep so as to leave a distinct cervical outline to guide in trimming the crown after swaging. The removal of the band may be easily accomplished by cutting through it at the narrowest and most convenient point, with a fine saw or file, after which the entire plaster outline should be nicely smoothed down, and then varnished.

**Mould.** The mould is obtained in the same manner formerly pursued in securing the dies, *excepting* that it is made of *plaster* instead of metal. The varnished model should be adjusted to the casting flask, or similar device, with pieces of cardboard *in situ*, Fig. 95, and thin plaster then poured upon it. After crystallization this may be broken open, the model removed, and the parts replaced and adjusted to the flask.

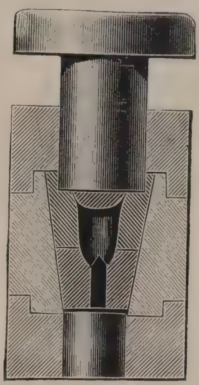


*Fig 101*

**Swaging Model.** When the plaster has become sufficiently dry, this should be filled with fusible alloy which melts at, or below, the temperature of boiling water. The metal model thus resulting, Fig. 99, is identical with the original model, and over this the blank of gold is conformed by various processes of swaging.

**Blanks.** After drawing the blank to a size which will fit snugly over the swaging model, or securing the same from the supply houses in ready-made form, it should be first thoroughly annealed, as any subsequent annealing is prevented after the swaging has been started, because of the necessity for the destruction of the swaging model, by melting it, to admit of the removal of the blank.

**Swaging.** In conforming the blank to the outlines of the swaging model, considerable care must be exercised to prevent knuckling and overlapping of gold by any method employed. This can only be accomplished by frequently removing the crown and working out such places with a small riveting hammer, Fig. 100.

**Methods.** While several systems and devices have been designed for the purpose of swaging crowns by this process, the cylinder and plunger are the essential features of the most useful ones, and even hydraulic pressure may be very serviceably employed.

Ash's crown swaging device can be made to answer the purpose by boring out the end of the plunger until it presents the form of a cone equal in depth to that of the average crown, and a similar apparatus especially designed to meet such requirements constitutes a portion of the seamless crown outfit manufactured by Mr. J. W. Place, of New York City. The *cone shape plunger* is necessary in order to distribute the impact evenly over the entire surface of the crown.

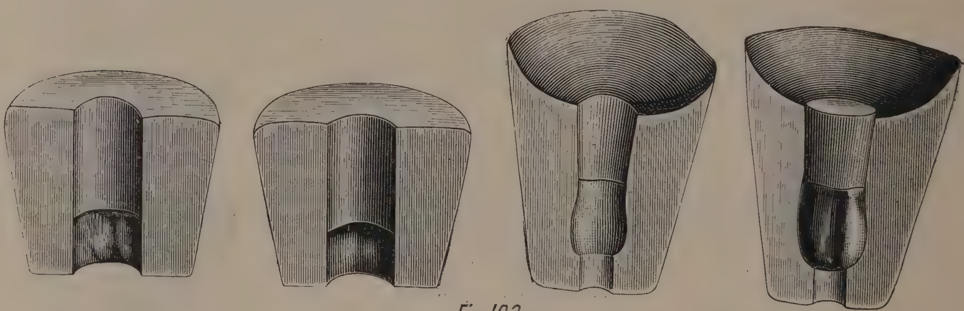


Fig 102

In the use of such devices the blank should first be fitted over the swaging model and gradually worked down to place with the riveting hammer. This should be placed in the center of the cylinder and oiled bird-shot or, preferably, stiff putty freely mixed with lycopodium or soapstone, then packed closely around and over it until entirely submerged. The plunger should now be inserted and gradually driven to place, removing the crown frequently and working out the overlaps, until the swaging is completed.

**Scott's Method.** The apparatus designed by Dr. W. P. Scott, of Chicago, which consists of an inverted cone shaped cylinder, and straight flat-surface plunger, with other necessary accoutrements, is among the most complete, simple and modern inventions for this work, though it is similar to, and used much in same manner as the Berry and Adamson outfits.

In the use of this system the blank is fitted to the swaging model as indicated, and the occlusal surface first swaged by driving the same into a surface of lead. After this portion of the crown is adequately swaged, it is then placed in a matrix afforded between the two surfaces of lead which are formed in a mould accompanying the outfit, and the

whole then dropped into the cylinder. The base and top of the latter are adjusted, and the plunger inserted, (Fig. 101,) which upon being driven deeper into the cylinder so compresses the lead matrix, and the gold blank, as to closely conform it to the outlines of the swaging model, with a minimum tendency to tear or overlap, and with a maximum and uniform increase in the thickness of the gold. The lead matrix before and after swaging, together with the crown in position in the latter, are illustrated in Fig. 102.

**Finishing.** When the swaging has been adequately accomplished by the method selected, very little finishing is usually required. The crown should be polished before detaching it from the metal model, after which the latter should be melted by placing in *boiling water,* and any adhering or remaining particles removed by the acid bath. The surplus gold at the cervical portion should then be carefully trimmed away to follow the outline indicated, when the necessary reinforcement and final polishing may be given.

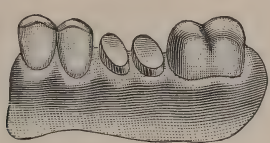


Fig. 103.

Fig. 104.

## Application to Separated Molar Roots.

The presentation of cases where molar roots have become separated at the bifurcation as the result of extensive disintegration of the crown, and with each individual root remaining *firm* in its attachment, is not an infrequent or unusual occurrence.

In such instances the application of a crown will not only often restore the roots to the former usefulness and supply the serviceability of the original tooth for many years, but will also frequently preclude the *impaired occlusion* of the adjacent teeth which their natural gravitation or tipping, as the result of the loss of such roots, would occasion.

This latter phase places a degree of importance upon the permanent retention of these roots, which, particularly in early life, and especially on *first* molars, makes such a procedure of inestimable value, and causes it to be almost universally indicated wherever such a condition is found in otherwise unbroken or well-filled arches, with the roots remaining reasonably firm.

**Procedure.** In the treatment of these cases the individual roots should be carefully prepared by observing the therapeutic and mechanical requirements, and each then built up *separately* with amalgam (anchored with a post, or by other mechanical retention) until they afford favorable shape for the permanent attachment of a band. (Fig. 103.)

**Bands.** Separate bands should be fitted to each, their *occlusal* ends trimmed to allow for the cusp, and contoured to approximate each other, and restore contact with adjacent teeth.

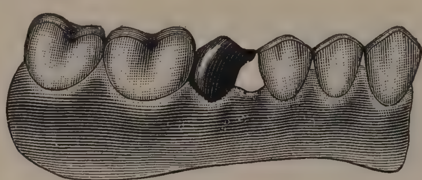


*Fig. 105.*

The usual bite in wax and impression in plaster should be secured, and the case finally mounted upon the articulator. After separating, and detaching the bands from the model in such manner as to preserve their outline and admit of accurate replacement, they should be readjusted to the model and united securely together with hard wax; then they may be removed and the *cervical* one-half imbedded in investment material. Their relation may now be permanently sustained by filling in between

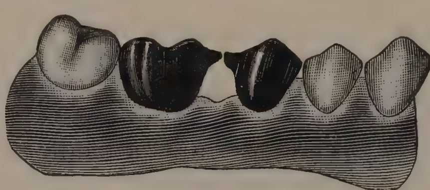


*Fig. 106.*

them with 22 karat solder, which union, involving the occlusal ends only, will leave a free, clean interproximal space. (Fig. 104.)

**Cusps.** The united bands may now be replaced upon the model and the cusps formed in the usual manner, as though for the single band of an ordinary crown. In attaching them, however, care must be exercised to prevent re-fusing the solder with which the bands were previously united, and thus chang-

ing or destroying the relation between them. The use of a lower grade solder will ordinarily preclude this, but to further facilitate it the cusps should be *filled* with solder after obtaining their proper adaptation, and previous to attaching them to the bands. Very little danger will then exist, and *any* may be entirely overcome by the use of a solution of whiting and alcohol, which precaution it is well to observe.

## Application to Individual Roots.

Where but a single root remains or possesses sufficient strength, and particularly in the lower jaw, it may often be retained and made serviceable for a number of years by the application of a crown. Also, in instances where such a root may be unusually strong, and the space formerly occupied by the normal tooth has become lessened or partially closed as a result of the loss of the other root and the gravitation of the adjacent teeth, it is often practical to extend the occlusal portion of the crown until it rests against the adjacent tooth, and thus affords a continuous masticating surface. (Fig. 105.) The contact point between such a crown and the natural tooth, however, should be *only* sufficient to prevent tipping of the root from the stress of mastication, and for prophylactic reasons should rest close to the occlusal surface and be smooth and well rounded.

## Cantilever Bridges.

A *small* intervening space between two artificial crowns may be bridged over until an unbroken masticating surface presents, by applying these same principles, as was originally suggested by Dr. J. N. Farrar. (Fig. 106.) Such a procedure would be most practical, however, in cases where a *very small* space existed, as one sufficiently large to accommodate a *dummy* could usually be best filled by constructing an assembled bridge.

## Application of Amalgam.

Amalgam is sometimes employed in the restoration of badly broken down molar roots by crowning, and, while good results in the line of expeditious operations combined with a moderate degree of preservation and permanency are probably possible, any method possessing only the advantages of *time* and cost of production, and requiring less skill and effort than a manifestly better and more *artistic* one, should very naturally occupy the limited sphere of application and usefulness accorded to this.

In conditions and environments, however, which seem to indicate the application of such methods, it is possible to obtain fairly good results in the restoration of the crowns of second and third molars, where the occlusion is very *close*, by either of the following procedures:

**With Band.** Where a permanent band may seem indicated as a means of supporting the remaining walls of the root, and to aid in the retention of the amalgam, it should be made of gold, carefully fitted and adapted, and then polished and cemented to place.

Provisions should then be made for securely retaining the amalgam. This may be accomplished either by means of a post, cemented into one of the canals, or by cutting a mechanically retaining cavity if sufficient tooth structure remains.

Very plastic amalgam should then be packed thoroughly to place, and built up to the desired cusp formation, until a favorable occlusion is obtained.

After crystallization, and preferably at a subsequent sitting, the amalgam cusps should be well finished and polished; and, while the gold band will have assumed the same color by the superficial absorption of mercury, its original color may be brought back by *polishing,* if desired.

**Without Band.** If a permanent band is not desired, or seemingly unnecessary, the entire crown may be made with the amalgam. In this procedure a *temporary* band of thin German silver, 32 to 34 gauge, should be made and adapted to the root, as indicated. This is used only as a matrix for aid in adapting and contouring the amalgam, and may be easily removed from the latter, after its crystallization, by cutting, after which the amalgam crown may be finished and polished. The easy removal of the band may be further facilitated by coating its inner surface with vaseline or oil before inserting the amalgam, which will prevent superficial amalgamation with it.

Where extensive destruction mav preclude sufficiently adequate retention for the amalgam, it may be *first* tightly packed to the surface of the tooth and matrix, and around the projecting end of a dowel temporarily adjusted to the canal if the use of the same seems indicated, *without* any provisions for its retention. After crystallization both may be removed, the band separated, and the crown then finished and polished. and finally mounted with cement, after serrating or roughening the surfaces of crown and root. Such operations, however, are of doubtful permanency as compared with those wherein a permanent band is employed.

## Application to the Anterior Teeth.

While it is difficult to conceive of a practice more flagrantly inartistic than the application of gold crowns to anterior teeth or roots, as has been previously observed, they are, nevertheless, occasionally employed.

In view of the opportunities for more artistic endeavors, and the increasing appreciation of and demand for the same, this class of gold crown is now the exceptional expedient rather than the common practice, and would doubtless soon become entirely obsolete were it not for a *limited* class of cases in which the requirements and environments seem to justify such a procedure.

Their application in any event, including even these exceptional conditions, should be made with an honesty of purpose, and a sense of professional duty, paramount to a mere catering to the perverted, unrefined vanity of the vainglorious.

**Indications.** The class of cases in which their application is practicable and warrantable is confined to the mouths of men past middle age, where they are partially or entirely hidden by the beard. In such instances the use of gold crowns may be indicated in *two* general classes of cases:

*First,* where, from a more or less powerful masticating action, and by

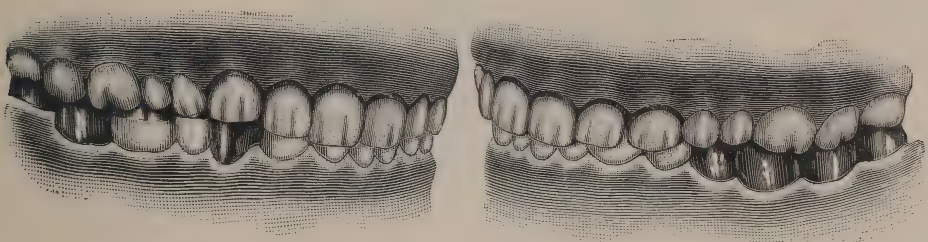


*Fig. 107.*

years of constant and continued attrition, the remaining teeth have become so worn down as to require restoration with an absolutely indestructible material. *Second,* in crowning the *cuspid* teeth, when they are to serve as abutments for bridgework, and where it is desirable, and perhaps necessary from a mechanical standpoint, to allow as much as possible of the natural crown to remain in order to secure the additional strength thus imparted to the attachment between crown and root; and where the practical invisibility of the work may not require any special effort toward securing the more artistic effects afforded by other means.

The first class of cases are not uncommon or infrequent, and usually present a more or less perplexing problem. If an adequate number of the posterior teeth remain, and occlude with teeth in the opposing jaw, a more artistic result may often be obtained by crowning the posterior teeth in such a manner as to *open the bite* sufficiently to accommodate crowns having porcelain facings on the anterior teeth, with reasonable

assurances of permanency and usefulness. But in the event of the loss or absence of properly occluding posterior teeth, all, or the greater portion, of the work of mastication may be thrown upon the remaining anterior teeth, and thus preclude the use of porcelain and occasion the necessity for gold, unless the posterior teeth be first supplied by artificial dentures.

Fig. 107 illustrates a case where the bite was opened by placing crowns upon the posterior teeth, with cusps sufficiently thick to withstand the work of mastication, and which thus admitted the application of porcelain-faced crowns to the anterior teeth. Fig. 108 illustrates a case where the absence of the posterior teeth indicated the use of gold on the remaining anterior teeth, and where the crowns were further fortified against the stress of mastication by tipping each with 26 gauge clasp-metal. The

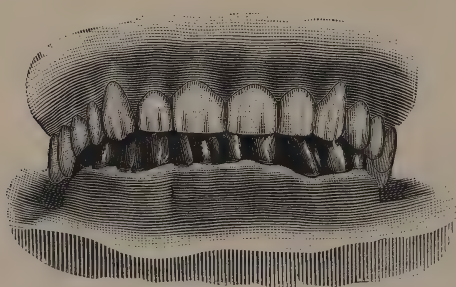


*Fig. 108.*

use of the clasp-metal is especially indicated where both upper and lower teeth are crowned and the crowns occlude with one another.

**Procedure.**

In the application of these crowns, several methods are employed. The requirements of root preparation, as have been outlined in general, include securing the greatest diameter at the cervix by reducing the coronal proportions, and further sacrificing the approximal, labial, lingual and incisal surfaces until the remaining structure will admit of properly shaping and contouring the crown, when the measurement should be taken as heretofore indicated. A band of 28 or 29 gauge, 22 karat gold should then be cut the exact length of the straightened measurement wire, and somewhat *wider* than the required length of the crown.

**Adaptation to the Mouth.**

As the correct adaptation can be most accurately obtained by fitting directly upon the root, and but little time is thus consumed, the use of models is unnecessary.

The band should be soldered, trimmed to meet the gum line evenly

(Fig. 109, a.), and then forced to place upon the root. When the cervical adaptation has been completed, the *lingual* portion of the band should be cut away, following the original curvature and outline of the tooth. (Fig. 109, b.) The labial surface may now be contoured with the pliers until it assumes proper shape and alignment, and restores contact with adjacent teeth, in which the artistic results possible are, of course, in proportion to the degree of skill displayed.

The incisal end should now be trimmed to the proper length and shape, with an allowance for the thickness of the lingual plate to be subsequently attached, and of the clasp-metal also, should its use be desirable or necessary.

A piece of gold, somewhat larger than necessary, 28 to 30 gauge, 22 karat, should be adapted to the lingual portion of the band, held in contact with pliers or wire, and soldered from the inside. (Fig. 109, c.)

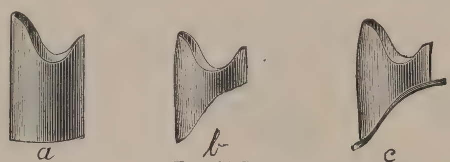


Fig. 109.

Adequate re-enforcement of the incisal end should be obtained by filling in sufficiently with solder, or by attaching a piece of clasp-metal, previously cut to the exact size and shape, along the edge.

The surplus should be cut away, and the crown subjected to the acid bath; then finished and polished.

**Adaptation to Models.**

When it may become necessary, or seem desirable, to construct the crown upon models, thus confining the work to the laboratory, a *narrow* primary band of copper or German silver, 32 gauge, should be fitted to the root, and an impression, including the adjacent teeth, then taken in plaster.

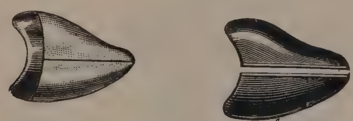
When this has been secured, the band should be adjusted accurately to place, and the model obtained with fusible alloy, which is preferable to plaster, being more indestructible.

With a sharp chisel or bur the *outside* surface of the band on the model should be first freely exposed, when it may be cut in two and detached. This will leave the adjacent teeth and the correct cervical outline of the root definitely exposed in the model, and the crown can then be constructed upon it in the manner indicated, with reasonable accuracy.

**Carving and Swaging.** Those who may experience some difficulty in shaping and contouring the labial surface with pliers in an artistic manner, may be able to obtain better results by carving and swaging both labial and lingual surfaces, though this method seems unnecessarily circuitous.

To accomplish this the primary band should be fitted, the impression taken, and a model secured in *plaster*. The band should be carefully detached from the model and the latter varnished. With the band again adjusted to position, the intended crown may be formed with plaster, which, after hardening, may be carved to the desired form. By the use of mouldine *separate dies* may now be secured of the *labial and lingual* surfaces, with the line of junction at the center of the approximal and incisal surfaces. (Fig. 110, a.)

Each surface should be swaged separately; the surplus trimmed away; the edges passed over a flat smooth file until they approximate



a b

Fig. 110.

Fig. 111.

evenly (Fig. 110, b.), and the two finally soldered, with sufficient incisal re-enforcement.

In this procedure the degree of accuracy obtained in the finished crown will depend much upon first drawing or designating a definite line between the two lateral halves of the plaster crown; then securing an imprint of each surface in the mouldine, having a well defined edge evenly approximating this line, and finally trimming away the surplus gold, after swaging, with care and precision before uniting the two with solder.

The accuracy and indestructibility of the metal model, however, supplemented by the definite reproduction of the diameter and cervical outline of the root, which is afforded by the primary band, aids materially in securing the desired result.

**Die-Plate Methods.** The various die-plate systems supplying a selection of dies of the labial and lingual surfaces may often be employed to good advantage, with perhaps increased artistic effect, and a reasonable degree of accuracy, though they give a more typical reproduction of tooth-form than is usually necessary or required, except possibly for the cuspid teeth, as considered in the *second* class of indications.

**Lowry and Millett Systems.**

The dies for this purpose contained in the Lowry and Millett systems include only the *labial* surfaces, and may be used in accordance with their application as formerly outlined. In their use the measurement is taken and a band cut the proper length and width. The die is selected which approximates the individual requirements of the case, and the immediate center of the band is then conformed by swaging; after which it is trimmed, as indicated in Fig. 111, made in circular form and soldered. It is now fitted and adapted to the root, trimmed to assume the proper lingual curvature, and to admit of the attachment of the lingual plate, as previously shown in Fig. 109.

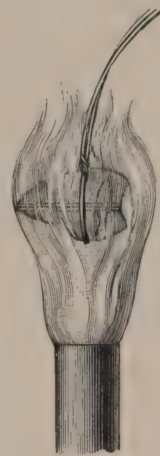


Fig. 112.

**Hollingsworth and Baird Systems.**

The Hollingsworth and Baird systems include separate dies of *both the labial and lingual* surfaces mounted on a single base, and may be used in similar manner, in accordance with their application, as previously outlined.

When the die which most closely approaches the requirements for side, size and form has been selected, the gold should be swaged, and both sides of the crown then trimmed until properly approximated. They should then be wired together, fluxed, and soldered from the inside. (Fig. 112.) While it may now be possible to so trim and shape the cervical end as to secure a fairly good adaptation to the root, a more accurate result may be obtained by adapting a narrow band of gold to the root and then fitting the crown *over* it, and subsequently attaching them with solder, when the incisal end may be adequately re-enforced and the crown finished and polished.

**Seamless Method.**

The application of the seamless method to the restoration of anterior *roots* is *identical* in detail to the procedure previously indicated in the construction of bicuspid and molar crowns. As the lingual outline of the adjacent teeth, however, will often serve as a guide, the taking of a "bite" becomes necessary only when the opposing teeth may be irregular, or where an incisal or "end to end" occlusion is required.

The primary band should be made and fitted in the manner outlined, and the impression secured in plaster. When the model has been obtained, the crown should be formed and carved, and the dies made in accordance with, and the swaging accomplished by, the process selected.

Seamless crowns are also especially useful for bicuspids where porcelain facings are to be attached.

**Reproductions.** In applying this method to the construction of cuspid crowns where the entire natural crown remains, accurate *reproductions* of the tooth may be quite easily made. To accomplish this, the natural crown must first be trimmed sufficiently on the approximal sides to admit of an accurate adjustment of a band to the cervix, and, if necessary, upon the incisal, labial and lingual surfaces, to admit of securing the proper length, alignment and occlusion. A *narrow* primary band should then be fitted to the neck of the tooth, and the impression and subsequently the model secured in plaster. The plaster tooth should now be cut from the model in the manner indicated in Fig. 91, and the dies or swaging model secured as the selection of processes may require. When the swaging has been completed, the crown will be a close reproduction of the tooth and will fit it accurately. Sufficient incisal re-enforcement to prevent wearing through, however, must always be made, even at the expense of grinding the natural crown, if necessary.

This procedure is sometimes employed without using the primary band, but is, of course, *less* accurate, as the band indicates the proper relation to the root under and within the free margin of the gum, which otherwise can only be *approximated* by trimming the model at this point.

**Dowels.** In those cases where the natural crowns are so badly worn or broken down as to afford inadequate attachment for the crown, the use of a dowel may become necessary as a means of supplementing the telescope attachment, and thus offering increased integrity. Their application may be made by first fitting them to the canal, and then allowing a projecting end to extend into the crown as far as its incisal edge will admit. After thus ascertaining the proper length, the dowel should be previously cemented to place in the root, and the crown subsequently attached.

## Application to Deciduous Teeth.

In some fortunately rare and exceptional instances, where the extremely poor character of the deciduous teeth precludes their temporary preservation by other means, and demands the employment of some heroic, or, perhaps, radical procedure to prevent their premature loss, the application of gold crowns may be indicated as the most simple, expedient and available means of preserving them until the time for the eruption of their permanent successors.

In such cases little or no preparation would of course be possible, or necessary, and good results may often be accomplished by covering the little crowns of such teeth with caps made of pure gold.

In the procedure a wire measurement of the cervical circumference should be taken, and then an impression in *wax,* from which a plaster model may be secured, which will afford sufficient accuracy for the purpose.

Pure gold about 34 gauge should be then cut the length of the measurement, made in circular form and soldered, and then fitted and shaped as accurately as possible on the model.

It should then be finally soldered, with but little reinforcement, and finished and polished.

The tooth should then be thoroughly disinfected, and the crown mounted with cement, and carefully burnished to a close adaptation with the neck of the tooth.

By this means this class of teeth may be saved until the proper time for their loss with the utmost expedience, and without unduly taxing the patients of such tender years.

## Ready-Made Forms.

As a woful acknowledgment and conclusive evidence of the lack of skill possessed by some, and of the ever-ready willingness of the supply-houses and commercial dentists to cater to and supply the *demand,* a large variety of ready-made seamless crowns, in gold and aluminum, are procurable *ad libitum.*

They are made of moderately typical form, in a gradation of sizes, of 22 karat, 30 gauge gold, and about 26 or 28 gauge aluminum, and in their use a measurement of the root is taken and a crown selected which approximates the same diameter. The cervix is then trimmed until a closure of the occluding teeth, with it in position, is possible, when it is fitted to the root with pliers, and, if of gold, re-enforced with solder and mounted.

The most accurate method of fitting a ready-made gold crown to a root is to cut a slit in each approximal surface, lap the edges, place the crown on the natural root and contract its cervical circumference by encircling the crown with annealed German-silver or copper wire and twisting the wire till the band is in good contact with the root. Adaptation is further perfected by burnishing, after which the slits are united with solder.

That such crowns may be correctly adapted to all the requirements of all environments is doubtless a claim which no conscientious skilful operator would make, because, while their individual formation is fairly typical of the natural teeth, it is difficult to conceive of securing a ready-made form which can be adapted to the requirements of cervical adaptation, approximal restoration, occlusion and alignment, all combined.

Indeed, these requirements are often difficult to obtain in a crown

which is made for the individual case, and at the expense of every degree of energy, skill and handicraft possessed by, and at the command of, the operator.

The progress of dentistry, and the artistic possibilities pertaining to it, have only been achieved by the development of a superior skill which cannot be acquired by the adoption of such indifferent methods.

## Removing and Repairing.

As a result of pathological disturbances arising beneath them, or for the purpose of substitution or replacement, it not infrequently becomes necessary to remove a gold crown from its attachment to the root.

In the presence of conditions demanding therapeutic treatment, it is sometimes possible to cut through the occlusal surface of the crown on a line with the pulp chamber, with a sharp, spear-point drill or round bur, and then enlarge the opening until adequate access to the canals is secured. The necessary treatment may then be made through this opening,

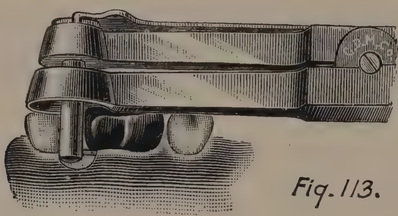


Fig. 113.

upon the completion of which the pulp chamber and crown may be filled with cement, and a gold filling, anchored in the cement, subsequently inserted until the opening is imperviously closed.

While such a procedure may be productive of successful results in some instances, particularly in bicuspids or single-rooted teeth, it should not be regarded as a *safe* one in most cases, because the presence of the crown only adds to the difficulties to be encountered in an operation which is usually trying enough under the most favorable circumstances, and with every advantage of access and light.

For this reason the removal of the crown is almost invariably indicated as a means of affording greater convenience and increased opportunities for success, and may be easily accomplished in two ways.

**Crown Slitting Forceps.**

Where it is not necessary to preserve the continuity of the band for subsequent replacement of the crown, and in emergency cases where its immediate removal is indicated or demanded as a means of affording relief, the crown slitting forceps may be used to good advan-

tage. Those designed by the S. S. White and the Consolidated Dental Manufacturing Companies, the application of which latter is shown in Fig. 113, are especially useful in securing the easy and expeditious detachment of the crown from the root.

In their use the flat beak should rest firmly upon the crown, and the sharpened one caught just under the edge of the band, when a slight compression of the handles will quickly separate it. The band may then be pried away from the root with a smooth flat burnisher until a pointed instrument can be slipped in between cusp and root and the crown lifted off, which may also be often done with the forceps alone.

**Preserving Continuity of Band.**

When the same crown is to be replaced, it may be desirable to remove it without destroying the continuity and shape of the band, thus distorting its adaptation. This may be easily accomplished by drilling through it with a round bur at a *convenient* point, as close to the occlusal surface as the probable thickness of the cusp will admit (Fig. 114), and then burring out as much of the cement between cusp and root as possible by a lateral movement of the bur. A stiff, blunt-pointed instrument, similar to an old hand-plugger, should now be inserted into the opening, until its end rests about on the center of the root, thus securing a leverage by the establishment of a fulcrum, when the crown may be lifted off with but little effort.

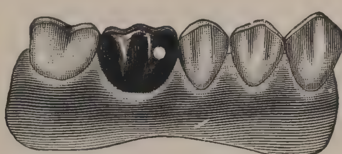


Fig. 114.

**Repairing**

While a crown removed with the slitting forceps may be easily repaired, as no material is destroyed, it is doubtful if the edges so cut can be again brought into proper relation and contact without requiring a readaptation to the root in case of replacement. Aside from this, the two procedures may be interchangeable and can be used as convenience and requirements may seem to indicate.

In either event, when repair is necessary, all remaining cement should be first removed with a bur, and the crown then thoroughly cleaned in acid, when the perforations may be filled with foil gold, and, together with other openings, then finally closed with 18 karat solder.

# The Shell or Telescope Crown in Combination with Porcelain.

VIII.

Indications. Application to Anterior Teeth: Jacket Crowns; Malformed Teeth, Extensive Abrasion, Procedure; Band, Facing, Backing, Soldering. Application to Irregularities. Application of Facings to Bicuspid Crowns: Procedure; Preparing Crown for Reception of Porcelain, Adapting Facing, Adapting Backing, Soldering Backing, Soldering Facing. Variation of Method. Application of Saddle-back Teeth to Bicuspid and Molar Crowns: Procedure. Dowels.

The application of porcelain facings to crown construction, wherein the shell or telescope principle of attachment to root is employed, involves several varied methods and processes, many of which are often indicated in special classes of cases, and may be productive of practical and artistic results.

While the modern application of the ceramic art doubtless offers far greater opportunities for more æsthetic and hygienic achievements in this line of work, the essential requirements of *strength* as applied to the method of attachment to the root, as well as to the completed crown, are factors not infrequently contraindicating its use. These, together with the absence of facilities, or the lack of experience and skill, may often indicate the combination of gold and porcelain as a means of obtaining increased strength, and of securing, or more closely approaching, the desired artistic and æsthetic result.

**Indications.** The application of this style of crown construction is especially indicated in that class of cases where it seems desirable, or becomes necessary to utilize a portion of the remaining natural crown for the attachment of the artificial substitute, by telescoping it instead of sacrificing it to the gum line and employing a dowel; and where the presentation of porcelain is essential to the artistic requirements.

Those conditions in which these combined requirements are particularly applicable, and the preferable and most practical methods of subserving them, will be considered in their respective classification.

## Application to Anterior Teeth.

The application of this style of crown to the six anterior teeth, upper or lower, is frequently indicated, but should be made only in the absence of a better method, and in accordance with the judgment and discretion of experience, because the practicability of the principles involved has been much abused by the indiscriminate and too extensive use of the design known as the jacket crown.

**Jacket Crowns.** The so-called jacket crown is often a most useful style of construction, but is particularly so in the restoration of malformed crowns of teeth, as previously indicated in Fig. 29, and in conditions of extensive abrasion. As the proportions of the remaining natural crown, however, are ordinarily retained at the expense of the *strength* of the artificial substitute, because of the limited amount of space, the requirements of occlusion and alignment must be, or be made, *favorable* to the reception of a crown possessing sufficient strength to withstand the stress. For this reason the use of gold in combination with porcelain facings usually affords greater strength than all-porcelain work.

**Malformed Teeth.** In the restoration of the crowns of malformed teeth the use of the jacket crown is particularly applicable because of the usual favorable shape and formation of the natural crown; and for the reason that it is often desirable to preserve the vitality of the pulp in such teeth, because of the probable unfavorable length and imperfect development of the root, which might often preclude securing adequate mechanical attachment of a dowel crown.

In such conditions the destruction of the natural crown would, of course, be of doubtful advantage, and sometimes even unwarrantable; and the preservation of the vitality of the pulp presents a favorable prognosis because usually so little mechanical preparation would become necessary that no great shock or irritation would be induced, and the dentine is not deprived of the protection of its coat of enamel.

**Extensive Abrasion.** This style of crown is also frequently indicated as a means of arresting the destructive influences of abrasion, and restoring the natural crown in a useful and æsthetic manner. If the occlusion in such cases is, or may be made, favorable for, and the requirements indicate the use of, porcelain facings, the preservation of the remaining natural crown may afford the advantage of a more accurate and perfect reproduction of the occlusal surfaces, and at the same time adequate stability to the attachment of the crown.

The advisability of destroying the vitality of the pulp in these cases is much a matter of judgment, but is not always essentially a prophylactic

measure, because such conditions are not usually found in early life. Hence, as a result of the combined influences of age and continued attrition, the pulps have usually receded, and the canals are not infrequently found to be partially or entirely obliterated. The degree of sensitiveness manifested during the necessary mechanical preparation will serve as a guide, however, in indicating the requirements in this connection.

**Procedure.** The first procedure constitutes the preparation of the remaining natural crown until its periphery presents a favorable shape for the accurate adaptation of a band, and the *labial, lingual* and *incisal* surfaces are sufficiently reduced to afford accommodation for a facing, and admit of a favorable occlusion. (Fig. 115, a.)

a b Fig. 115. c d

**Band.** A band of about 30-gauge 22-karat gold should then be fitted to the root, passing just freely beneath the gum. After completing the adaptation of the cervical end, the *labial* portion should be cut away on a gradual slope, closely following this surface of the remaining crown, until the facing may be carried to the gum line. The lingual portion of the occlusal end should then be trimmed until it offers no interference to the occlusion, after which the interior of the band, in position on the root, should be filled even to its edge with wax, and the bite and impression secured.

**Facing.** When the model has been obtained and mounted upon the articulator, a facing of the thin neck variety of mould (Fig. 115, b.) should be selected and ground to place, with a slight allowance for the thickness of the backing.

**Backing.** Pure gold, 34 to 36-gauge, should be closely adapted to the entire lingual surface of the facing, so as to join or come in direct contact with the band along its labial and cervical edge when adjusted to position (Fig. 115, c.). When the backing has been properly burnished and trimmed, and anchored to the facing by bending the pins, the band should be detached from the model, then replaced in position and the proper relation between it and the facing sustained with adhesive wax. The joint between the band and

backing should also be filled with melted wax as a means of keeping it clean and facilitating the subsequent union of the two with solder.

**Soldering.** When invested, the wax should be removed and a small cap of 22-karat or pure gold closely fitted to the *interior* edge of the band. The case should now be fluxed, heated and soldered, with as much re-enforcement and contour as the occlusion will permit. (Fig. 115, d.)

In cases where a broad, flat contact surface for the opposing teeth may be required, successive layers of clasp metal may be attached with solder until a favorable occlusion is secured. In this event the incisal end of the thin pure gold backing must be also adequately re-enforced with solder, though a better method of backing for such cases will be subsequently considered.

It will be noted that the adaptation of the crown to the projecting conical end of the natural tooth is not close, but a closer conformation is usually unnecessary if the cervical edge fits, as the increased quantity of cement thus used in mounting adds materially to the strength of the attachment.

If, for any reason, a more perfect adaptation may seem indicated, or desirable, it may be easily secured by burnishing or swaging a cone of pure gold, 34 to 36 gauge, or platinum foil, 1-1000 in thickness, to the tooth in the mouth, after the band has been fitted and trimmed; then adjusting first the cone and then the band to position, removing them *in situ,* with their relation sustained with wax, and investing and soldering them, when the crown may be completed as indicated.

Such a procedure is seldom required or even warrantable, however, because so little cement could be used in mounting that a more or less weak attachment would necessarily result. While the simple telescoping cone is sometimes used without the band, the latter is essentially advantageous as a means of securing sufficient strength at the cervical end and adequate adaptation to the root beneath the gum.

When the crown has been finished and polished, the remaining natural tooth should be roughened or slightly serrated with a thin edge stone, or sharp bur, before mounting, as such a procedure offers a mechanical supplement to the adhesive properties of the cement, which affords increased strength in the attachment.

## Application to Irregularities.

The jacket crown may also be found occasionally useful in the treatment of irregularities, where the character and position of the teeth, and the age of the patient, may not warrant the usual procedure for their correction.

The method advocated by Dr. George Evans is illustrated in Fig. 116, and consists of constructing a gold crown for the malposed tooth, and then attaching a facing to it by means of a heavy round wire, so adjusted as to carry the facing in its proper relation to the adjacent teeth, and to be free of the occlusion.

The more or less conspicuous appearance of the gold crown, even

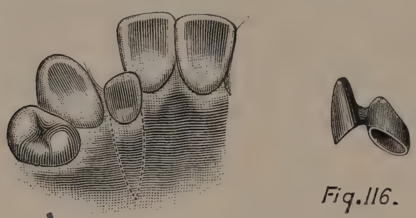


Fig. 116.

though partially hidden by the facing, is an objectionable feature, however, and equally useful and more artistic results could be usually obtained by sacrificing the natural crown and adapting a dowel crown to support the facing in its proper position.

## Application of Facings to Bicuspid Crowns.

As a means of eliminating the objectionable and conspicuous display of gold in crowning the bicuspids, the application of porcelain facings to gold crowns is frequently indicated, and, if skilfully executed, approaches the more artistic results achieved in the use of porcelain work, or dowel crowns.

While various methods are advocated and employed, a slight modification of the one suggested by Dr. Hollingsworth meets the requirements in the most practical, artistic and expeditious manner.

**Procedure.**

In the procedure the gold crown should be first constructed by any of the various methods in which the swaged cusp is used, but the band and cusps should be soldered with 22-karat solder, and *no* re-enforcement of the cusp made at the time of uniting it to the band.

When thus completed, and roughly finished, the root should receive further and proper preparation for the accommodation of the porcelain facing. This constitutes sacrificing the buccal surface on a gradual slope to the lingual, at an angle sufficient to admit of the presence of the facing when placed in position on the crown, as previously illustrated in Fig. 40.

**Preparing Crown for Reception of Porcelain.** The crown should now be adjusted to the root and the outline of the exposed area, to be occupied by the facing, marked in the gold with a sharp-pointed instrument, and subsequently cut out with a fine saw, as indicated in Fig. 117, a.

After filing the edge smooth and even, with the convex surface of a fine half-round gold file, a thin *cuspid* facing of proper size and color should be selected and ground to place.


a b c d
Fig. 117.

**Adapting Facing.** While the grinding may be done on models, when necessity or occasion requires, the most accurate results can be accomplished by filling the interior with wax, when in position on the root, and completing the adaptation in the mouth. In grinding to the necessary alignment, and approximation with the edge of band, care should be exercised to avoid sharp angles and any unnecessary weakening of the pins.

**Adapting Backing.** When the desired adaptation has been completed, a sufficient allowance for the thickness of the backing should be made by further grinding the facing or the band, or both; and the facing then backed up with pure gold, about 34 gauge. In the adaptation of the backing a small surplus should be allowed to project beyond the facing at all points (Fig. 117, b), and care must be exercised to avoid overlapping it, to accomplish which it may sometimes be necessary to cut out a small V-shaped piece at each occlusal angle.

**Soldering Backing.** The facing and backing should now be placed in position on the crown, and a sharp instrument passed around the buccal edge of the crown, marking the proper relation between it and the backing (Fig. 117, c), after which it should be detached, and the backing soldered to the crown from the *outside* with 20-karat solder, using enough to form a *smooth* joint, which may finish down *flush* with the porcelain when the surplus is removed;

and the necessary re-inforcement of the cusps should be made at this time.

The proper relation between the parts may be most easily and securely

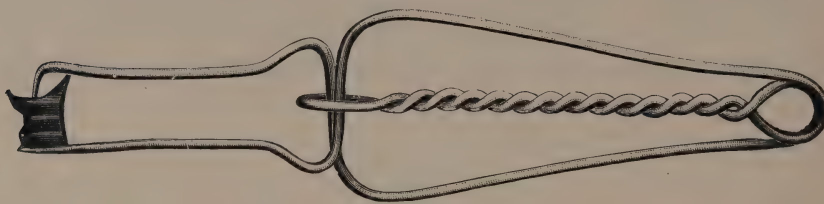


*Fig. 118.*

sustained while soldering by the use of pliers similar in design to those previously recommended for attaching cusps, or the ordinary nickel automatic soldering tweezers may be used by bending one end at right angles, as indicated in Fig. 118.

When the soldering has been completed, the facing should be adjusted to position and the surplus trimmed down until a *smooth* edge presents between crown and facing, being careful to *avoid any over-hanging edges of metal upon porcelain.*

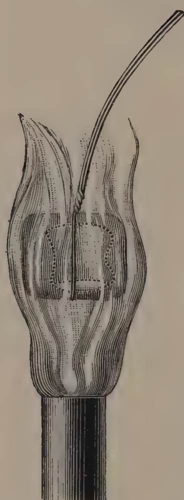


*Fig. 119.*

**Soldering Facing.** While the permanent retention of the facing may be secured by bending the pins down against the backing, on the inside of the crown, greater strength will be obtained by soldering, on account of the extreme thinness of the backing. This may be quite easily accomplished by first bending the pins down close upon the backing, and then wrapping the crown with one thickness of asbestos paper, with the *occlusal* end folded together, and the whole held in place by wiring. The backing and pins should then be fluxed, preferably with liquid flux, and a sufficient quantity of 18-karat solder also fluxed, and placed in position. This should now be carried to the flame, with the *porcelain downward,* and *gradually* brought to the point of greatest heat (Fig. 119), when a small flame from the blow-pipe may be directed upon the facing until the solder fuses, which can be readily observed from the open cervical end.

While this or any other style of investment is not altogether necessary, if extreme care be exercised in subjecting the crown to the heat, the

use of asbestos paper possesses the advantage of absorbing but little, if any, heat, and of precluding the possibility of fracturing the facing, by distributing it evenly.

When the soldering has been completed, the crown should be treated to the acid bath, and then finally polished (Fig. 117, d), and mounted.

If an undue prominence of the root interferes with its proper adjustment, it may become necessary to sacrifice more from the buccal surface, but the lingual surface should always be allowed to remain as long as possible, in order to afford the greatest degree of strength to the attachment.

**Variation of Method.** Another process or method productive of practically the same results, but entailing a different procedure, is employed by many. This constitutes first making the band, and fitting it to the root, and then cutting out the buccal surface to accommodate the facing as indicated in Fig. 120, a.

*a* *b* *c* *d*

*Fig. 120.*

The usual bite and impression should now be taken and the models secured and mounted upon the articulator. A cuspid facing of suitable size and color is then ground to place until the proper alignment, and a perfect joint with the cervical and approximal edges of the band, are secured. After backing the facing with 30-gauge 22-karat gold, and bending the pins (Fig. 129, b), the band should be detached from the model, the facing placed in position upon it, and their relation sustained with a *minute quantity* of fluxed wax. Asbestos paper should now be wrapped around the parts and wired, as indicated, and the joint between the two filled with 20-karat solder (Fig. 120, c).

This portion of the crown should now be readjusted to the models, and the cusps formed to fit the band and facing, and meet the requirements of occlusion, after which they should be filled with 18-karat solder.

In attaching the cusps to the band and facing they should be first retained in proper relation by the use of a small quantity of fluxed wax. Asbestos paper should now be wrapped around the crown with the occlusal end knuckled in *close* to the cusps, and then wired securely to place

by twisting the wire very taut around the approximal, occlusal and cervical surfaces, to sustain the relation of the cusps, as well as having an additional piece of wire pass around the center of the crown to hold the paper together.

With the surplus ends of the wire projecting from the *cervical* end of the crown, it may be carried to the flame, *cusps downward,* and so held until the solder, already in the cusps, has re-fused and united with the band.

If insufficient solder has been placed in the cusps to accomplish union in such manner, more may be added at this time, and, as in the previously mentioned method, if any danger of re-fusing or unsoldering joints, already made, seems probable, the same can be overcome and prevented by first coating them with a solution of whiting in alcohol or water, or other similar means.

After soldering, the crown should be allowed to cool slowly and gradually, and then may be removed from the investment, finished and polished (Fig. 120, d).

While such crowns may be invested in ordinary investment material, the soldering can be accomplished with equal facility and accuracy, and much more easily, in this manner.

## Application of Saddle-back Teeth to Bicuspid and Molar Crowns.

The application of the saddle-back tooth to the construction of bicuspid and molar crowns is sometimes practicable as a means of admitting of the shell or telescope principle of attachment, and of affording an artistic and æsthetic result, because of presenting an occlusal surface of porcelain.

The element of strength possessed by such a crown, however, depends much upon the extent of space, and the force of the masticating stress, in the individual case, as the *lingual cusps* are weak points, unless sufficient space exists so as to require but little, if any, grinding, and adequate opportunity is offered for protecting and supporting them.

**Procedure.** In the procedure incident to the construction of such a crown, the band should be made and fitted in the same manner pursued for an all gold crown, and the bite and impression then taken.

The root should be afterward trimmed to accommodate the presence of the porcelain.

When the models are mounted upon the articulator, a saddle-back tooth (Fig. 121, A), the occlusal surface of which approximates the size and proportions of the band, should be selected. In no instance should the porcelain be much *smaller* than the diameter of the band, but in the

event of its being too large it may, of course, be ground to proper proportions.

The band should now be detached from the model and cut away with curved-pointed shears to admit of the proper adjustment of the porcelain (Fig. 121, b).

The porcelain should then be carefully ground until it meets the requirements of alignment and occlusion, comes in contact with the remaining cervical edge of the band, and fits into the *interior* of the lingual and occlusal portion.

It should now be backed up with pure gold, about 34 gauge, securely attached by bending the pins (Fig. 121, c), and then placed in position on the band, and the proper relation sustained with melted wax.

After filling the interior with soft wax to keep it clean, the crown should then be invested by submerging it in a slight covering of investment material, leaving only the wax exposed.

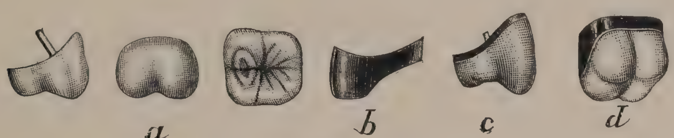


Fig. 121.

Upon removing the wax the interior of the crown will be exposed, when flux can be applied and sufficient solder placed over the pins and around the joint. The case should then be gradually heated to a red heat, when a small flame from the blow-pipe, directed *into* the crown, will quickly accomplish the soldering.

When removed from the investment and subjected to the acid bath, the band should be burnished up closely to the porcelain, and the crown finished and polished (Fig. 121, d).

**Dowels.** In the application of crowns constructed by these latter methods, the shortness of the root may sometimes indicate the use of a dowel as a means of supplementing the band and affording a stronger attachment to the root. When this is required, or seems desirable, it should be first fitted to the canal and a projecting end extended into the lingual portion of the crown as far as its proper adjustment will admit. The dowel should then be cemented to place in the root, and the crown separately and subsequently mounted.

# The Band and Dowel Crown.

CHAPTER IX.

Indications. Requirements: Mechanical, Esthetic; Cervical Curvature, Alignment, Color and Harmony, Oil Colors, Manufacturers' Products. Dental Laboratories. Method of Construction: Procedure; Bands, Soldering, Fitting. Forming Cap. Dowels. Bite. Impression. Adaptation of Facing; Cervical End, Incisal or Occlusal End. Backing of Facing; Adaptation. Re-enforcement. Soldering, Finishing. Variation in Method. Use of Platinum. Investing. Soldering. Finishing. Application of Partial Bands: Comparative Advantages, Indications, Procedure. Application of Riveted Facings: Procedure, Riveting. Application of Detachable and Replaceable Facings: Advantages Claimed, Advantages Considered, Advantages Obtainable, Various Designs; Mason's Facing; Application. Roach's Facing; Application. Dwight's Facing; Application. Bryant's Method: Applicttion; Box Method, Tube Method. Davis Crown. Application to Bicuspids and Molars: Indications; Bicuspids, Molars. Procedure; Re-enforced Cap, Use of Two Dowels, Bite and Impression. Use of Flatback Facing, Facing, Cusps, Adaptation, Approximal Restoration, Investing, Soldering. Use of Saddle-Back Teeth: Procedure. Use of Vulcanite Teeth. Application of Removable Crowns. Application to Irregularities: Indications; Malposition, Construction, Extension for Support of Facing, Hygienic Considerations. Diminution of Normal Space; Separation of Teeth; Application of the Intradental Band; William's Method, Application; Cigrand's Method, Application. Repairing: Replacement of Facings; Usual Method, Procedure. Brewer's Method; Application. Underwood's and Mitchell's Method; Application. Dwight's Method; Application. Bryant's Method; Application. Replacing Bicuspid and Molar Facings. Replacement of Facing and Backing; Procedure. Removing; Use of Excising Forceps, Separating Cap and Dowel; Accuracy in Model Making, Improved Articulators.

The usefulness and seviceability of the band and dowel crown in the various phases of its present application and construction account for its extensive employment, and warrant giving special emphasis to the detail of the respective methods advocated.

While the primitive application of a band as applied particularly to the construction of anterior crowns, and combined with a dowel and porcelain tooth or facing, was probably first suggested by Dr. C. M. Richmond, the present methods of construction, and the facil-

ities for accomplishing the requirements, have so modified the original design as to cause its complete abandonment, and the adoption of a procedure more practical, artistic and expeditious.

As there have been innumerable processes proposed, only the more practicable of those now in use will receive attention.

## Indications.

Because of the necessary use of porcelain for esthetic reasons, and of the additional strength and stability in the attachment afforded by the presence of a band, together with the hermetical sealing of the root and the safeguard against fracture, this style of construction is indicated in, and universally applicable to, the restoration of the ten anterior teeth, and not infrequently the first molars. Within the sphere of its application it occupies the same degree of general utility, and offers the same assurances of favorable permanency as does the gold crown in the restoration of posterior teeth.

## Requirements.

As the application is confined to the range of vision, the requirements in connection with the construction of such crowns may be properly classified as *mechanical* and *esthetic,* and yet in all efforts calculated to be productive of a high degree of permanency and artistic endeavor the two cannot well be disassociated.

**Mechanical.** Whilst it is now generally conceded that the addition of a band to dowel crowns affords the previously mentioned advantages, it is also readily acknowledged that the mechanical adaptation, or relation, of the same to the end of the root must be uniformly deep, and close enough to the periphery to preserve the continuity of surface between root and crown at the line of junction beneath and within the free margin of the gum, so that no irritating influence may result. At the same time, it is almost equally essential that the band should be sufficiently *narrow* to be entirely invisible, and thus admit of bringing the porcelain into close proximity with the gingival margin; and yet *strong* enough to retain its given shape and form during the process of fitting and adapting, and when subsequently subjected to the stress of mastication.

The importance of properly trimming the end of the root to begin with, has already been sufficiently emphasized, and is particularly apparent in the shaping of anterior roots, because of their even more conical shape. If this is neglected in the slightest degree, the cervical edge of the band must form a shoulder between it and the surface of the root, which, though hidden by the gum, affords opportunity for the lodgment

and accumulation of food deposits, the subsequent decomposition of which is productive of a decidedly unhygienic condition, and much consequent discomfort. While nature may aid the indifferent, careless or negligent operator for a time, by covering over the evidences of such efforts—and in this connection the tissues surrounding roots supporting artificial crowns cover a multitude of sins—the result is inevitable; hence, *no band at all were better than one which does not fit.*

**Esthetics.** In the esthetic restoration of the crowns of anterior teeth, success, with all it implies, is codependent upon the ability to observe the minutest details in an endeavor to simulate nature, and that degree of enthusiasm and ambition which prompts a thorough and efficient execution of the artistic requirements involved.

These embrace a consideration of the details of Cervical Curvature, Alignment, Color and Harmony.

**Cervical Curvature.** In order that the natural cervical curvature of the gum tissue should remain normal, and that no metal should be visible in the finished crown, it is essential that its adaptation should be made with this requirement in view.

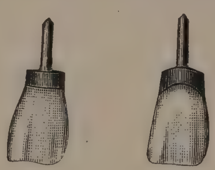


*Fig. 122.*

A common fault of this kind, the disregard of which materially increases the artificial appearance of the work, as compared with the correct and artistic outline, is illustrated in Fig. 122.

**Alignment.** The feature of alignment with adjacent teeth is most important, and particularly as applied to the *cervical* half of the crown. A common fault with many crowns, otherwise artistic, is an undue prominence at the neck, which is caused by not cutting the labial portion of the root *short* enough. or by the selection of a facing too thick or bulbous at this point, and the failure to properly reduce it, by grinding, before the completion of the crown.

A proper and equally symmetrical alignment of the incisal end should also be observed, and, while the occlusion may govern to some extent, it is often permissible to grind interfering opposing teeth slightly to admit of securing this. In this connection considerable trimming and shaping

of the ends and uneven and irregular edges of natural teeth may often be done to their improvement and benefit, and entirely without harmful or injurious results, if done carefully and judiciously, such surfaces being afterward polished smooth with fine disks.

**Color and Harmony.** As nothing in nature is more apparent than the universal expressions of *harmony,* it is, of course, essential in simulating it that every effort should be expended, and every facilitity employed, to obtain this in the construction of artificial crowns, that they may more closely resemble the remaining natural teeth.

**Color.** The selection of a tooth or facing of the proper color, with due allowances for any change which may be occasioned by the presence of a metal backing, or other means of diminishing its translucency, is often a difficult and very exacting problem, and those who are so unfortunate as not to be endowed with an accurate and artistic eye will often be seriously handicapped.

The color should be selected with these possible changes in view, and, particularly in the restoration of the six anterior teeth, should usually *match the natural tooth corresponding to the one being crowned* (if present), as a variation in the color of natural teeth in the same mouth is marked, to which special attention has been given in a splendid contribution by Dr. E. C. Royce, of Chicago. If some variation seems unavoidable, a slightly *darker* shade is usually preferable to a lighter one, and effects a less conspicuous and in consequence more artistic result.

**Oil Colors.** The use of the high-fusing oil colors, introduced by Mr. Robert Brewster, of Chicago, or a lower-fusing variety made by C. Ash & Sons, makes it possible to obtain almost any desired variation of shade in a single facing, as well as to more perfectly and artistically imitate the characteristics of the remaining natural teeth. These are prepared in several basal or primary colors, and in obtaining color and shadow effects are to be thinly mixed and painted on the *lingual* surface of the facing, immediately after the grinding has been completed, then placed in the furnace and fused, after which, when the desired result has been obtained, the crown is constructed as intended.

In reproducing pits, grooves, erosion, tobacco stains, etc., the colors are to be painted upon the labial surface, after properly grinding, and then fired before backing.

**Harmony.** Harmony in shape, form and characteristics is scarcely second in importance to color, and at least in salient features should be closely observed, as the artistic possibilities increase in proportion thereto.

The shape and general form of the porcelain tooth or facing should be the same as the corresponding natural tooth (if present); the length from cervical to incisal edges should be the same as the adjacent teeth; the angles and incisal edge should be characteristic of the remaining teeth, and in the event of the presence of numerous and conspicuous gold fillings the artificial crown should be similarly treated.

**Manufacturers' Products.**

In complying with such requirements *too* much should not be expected of the manufacturers and supply houses, as it would be impossible for their best efforts to be productive of results which could reasonably be expected to be universally adaptable to all cases. Their products represent only the efforts of the *artisan* in catering to the general *demand,* and the successful operator *only* can and must become the *artist.*

A selection which *approaches* the requirements should be made, and then ground and shaped as the characteristics of the case may indicate. In

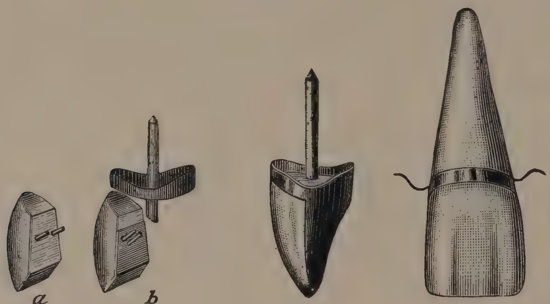



Fig. 123.

nearly all makes of porcelain teeth this can be done with impunity if the surfaces so ground are afterwards repolished with fine disks, and the result is even more natural than the highly glazed surface.

**Dental Laboratories.**

It is this particular feature that should impel the progressive, conscientious dentist to acquire such skill as may enable him to execute his own work, for the practice of relegating this class of work to *dental laboratories,* where, in the majority of them, the motto observed in making *bands* is to have them *large* enough to admit of easy and ready adjustment; where *cusp-forms* are made by the office boy, by the score; where the *color* is but a chance; where accompanying instructions that the *bite* is *normal* will suffice, and where *time* and *revenue* are necessarily the only serious considerations, should be condemned as materially retarding the progress and advancement of an artistic ,eld of professional effort.

## Method of Construction.

In a consideration of the method of constructing this style of crown, the consecutive stages of which are illustrated in Fig. 123, special emphasis must again be given to the essentials of root preparation, and particularly to the feature of allowing the end to project about one-sixteenth of an inch from the gum *until the peripheral trimming has been accomplished, the measurement taken, and the band fitted.*

The importance of this procedure has already been sufficiently emphasized, and cannot be overestimated, as a neglect to observe or a disregard of it will add materially to the difficulties encountered, and to the degree of inaccuracy and discomfiture resulting.

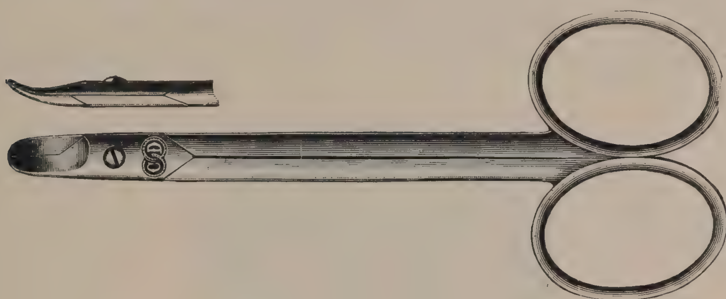


Fig. 124.

**Procedure.** When the remaining natural crown has been cut to the desired extent, and the projecting end of the root properly trimmed, the measurement should be taken in the manner already indicated.

**Bands.** A band should now be cut the exact length of the measurement, about *one-eighth* of an inch wide, and of 22 karat gold, 28 or 29 gauge in thickness.

**Soldering.** The edges should be filed straight and smooth, and the band annealed and made into circular form. By first overlapping and then *abutting* the ends, their contact may be sustained when heated, as already described, and the joint should be soldered from the *inside* with a *minute* bit of 22 or 20 karat solder.

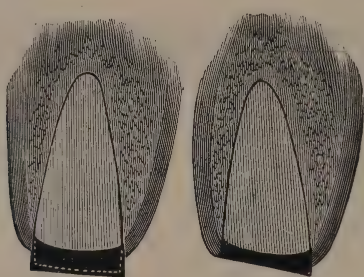
**Fitting.** The first procedure incident to fitting the band should be to give it a general shape approximating that of the root, and then to trim the cervical edge to closely follow the curvature of the gum, with the joint at the center of the lingual surface. Curved pointed plate shears, or the crown shears espe-

cially designed for such trimming (Fig. 124) may be used for this purpose.

When thus trimmed so as to come in uniform contact with the gum when loosely and temporarily adjusted to the end of the root, the edge should be filed *smooth* with the convex surface of a fine half-round file (Grobet, 4 to 5 inch, No. 5), and then nicely *rounded,* always avoiding a thin feather-edge for the reasons mentioned.

The band should now be placed upon the projecting end of the root, and then forced gently to position with a small piece of wood, until it passes just freely beneath the gum. (Fig. 125, A.)

While the topical application of solutions of cocaine, carbolic acid, etc., are frequently relied upon as a means of obtunding the pain, the use of any therapeutic agent is seldom necessary where the band *fits* a projecting end of a properly prepared root, as this serves to first *conform* it to



a b

Fig. 125.

the proper shape, and then *guide* it to place, thus causing little, if any, discomfort. A very great percentage of cases where any acute pain is occasioned can usually be attributed to forcing the band *into* the tissue, instead of its closely following the outlines of the root, and passing under and within the free margin of the gum, without unnecessarily impinging upon the periosteum or peridental membrane.

When the cervical end has been properly adapted, the band should be removed and trimmed until the *labial* surface is as *narrow as possible* to meet the requirements, but gradually sloping until it is somewhat wider upon the lingual.

It should now be readjusted to the root and forced well to place until it is entirely *invisible* from the labial aspect. The root should *then* be ground down until its basal surface follows the outlines indicated and approximates the edge of the band. (Fig. 125, B.)

While this relation may be obtained by grinding the root down with the band in position, it is usually best to remove the band during the procedure, for the reason that it may become loosened from the vibration, and slip downward unobserved, thus endangering the distortion of its shape; or, of being ground too narrow to be useful; and the heat produced by the friction is also an objection to grinding and shaping a band in the mouth.

When thus properly trimmed, it should be removed with a small hook instrument, and the floor then attached.

**Forming Cap.** The floor to the band, in the attachment of which the cap is formed, should be *thin* enough to be easily adapted to contact with the edge of the band, and admit of bringing the neck of the porcelain facing into close proximity with the gum.

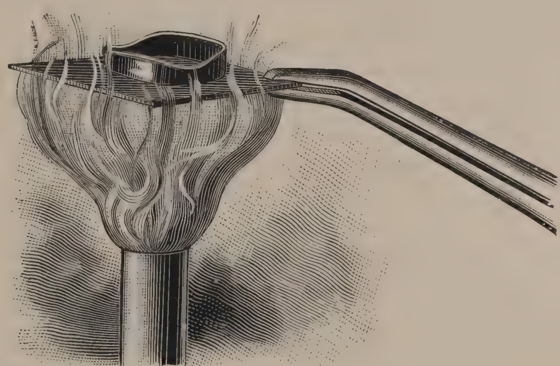


*Fig. 126.*

For this purpose, platinum, about 34 gauge, is preferable, as affording the desired thinness without danger of being fused in the subsequent final soldering of the parts; although pure gold, or even gold of 22 karat, of the same gauge, may be used.

Any special degree of strength in the floor itself becomes unnecessary *in gold work,* because of the quantity of solder which will be subsequently used in uniting cap and facing, and properly contouring the lingual surface.

In soldering the floor to the band, a liberal surplus of the metal (gold or platinum) should be used, and will facilitate the procedure. The band should be placed in the center of this, without any special effort to secure a perfect adaptation at this time, the parts then fluxed and attached at *one* point of contact by the *partial* fusion of a small bit of 20 karat solder

placed *outside* of the band. This will anneal the floor metal so that it may readily be burnished to a perfect contact with the edge of the band; and absolute contact around the entire circumference is essential, as an opening or space filled only with solder may be again opened by the re-fusing of the solder in the final assemblage of the crown. In securing this contact, however, care should be exercised to prevent changing the shape and form of the band.

After applying flux, one corner of the floor should be grasped with fine-pointed soldering pliers, and again carried to the flame, until the complete fusion of the solder formerly used unites the parts around the entire joint. (Fig. 126.) It will seldom be found necessary to make a second application of solder, for the quantity required, where good contact exists, is almost infinitesimal.

After the soldering has been completed, the surplus of floor metal should be trimmed close to the band, and the joint then finished down smooth, with stones and disks.

When adjusted to position on the root, the cap should rest firmly upon its seat, and any tendency to rock should be relieved. Rocking usually indicates a high point on the extreme approximal edge, the removal of which will overcome the difficulty.

### Dowels.

The cap should now be removed, and the canal prepared for the reception of the dowel, the requirements of which have been already outlined.

As the dowel assumes the greater portion of the strain to which the crown will be subjected, the alloy of platinum and iridium is generally used, because of its toughness and strength; and the round, square and triangular wire, in sizes varying from 14 to 18 gauge, according to that indicated by the proportions of the root, are prepared for the purpose.

The so-called "platinoid" and other German silver alloys are also prepared and used for this purpose, but the only advantage possessed by them is that of economy, and this is gained at the expense of stiffness, strength and permanent integrity.

If there is any preference as to the *form* of wire used, it is in favor of the *round,* because of its being easier to remove from the canal after mounting, in case of necessity; and of its being perhaps also easier to perforate the floor of the cap in such manner as to secure a close contact between it and the dowel at the line of junction, which facilitates and adds strength to their union, and prevents the solder from flowing in upon the under side of the cap. For this reason, should a square dowels seem desirable, round wire, of heavier gauge may be used, and that part which

enters the canal filed square after fitting to the hole in the floor but before soldering.

The advantages claimed for the square and triangular forms are that a wire drawn with sharp angles possesses greater strength and resistance than a round one; and that any possible rotation of the crown on conical roots, after mounting, is precluded. If the wire used is of *adequate size to meet the requirements,* the round form possesses sufficient strength, however, and there can be no rotation, if the crown is well adapted and the mounting is secure.

In fitting to the canal a length should be cut which will afford some surplus, and one end then slightly *tapered.* When the dowel has been properly prepared and adapted, the cap should be placed in position and a large round or oval burnisher used to outline the opening of the canal, in the floor. A *small* perforation through the center of this outline should now be made with a sharp pointed instrument, or bur, and the dowel then grasped *firmly* with pliers and the tapered end forced through the floor and into the canal until in proper position, which insures a close contact between dowel and floor.

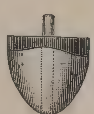


*Fig. 127.*

When properly adjusted, the relation should be *at once* permanently sustained by soldering, to accomplish which base-plate gutta percha, temporary stopping, or adhesive wax, should be warmed and packed around the projecting end of the dowel, and over the surface of the cap. When this is cool, which may be hastened by a spray of cold water, they should be carefully detached from the root, and the interior of the cap filled with plaster or investment material, until the dowel is covered. (Fig. 127.) The use of any more investment material than absolutely necessary only adds to the difficulty of soldering, and it is essential that it should be packed down into the cap well to prevent burning the band. After this investment has crystallized, the removal of the temporary medium, by warming over the flame, will admit of securely attaching the parts with solder by the use of the small mouth blowpipe.

In the event of accidentally making too large a perforation through the floor, an additional piece of the metal of smaller dimensions may be properly perforated and burnished down over the surface before removing

and investing the cap and dowel, and subsequently attached at the time of soldering.

The cap should be cleaned in the acid bath after removing from the investment, and then adjusted to position on the root and the bite and impression taken.

**"Bite."**

In the construction of anterior crowns, the taking of a "bite" usually becomes necessary only when some abnormality of occlusion, or irregularity of the opposing teeth, presents. Otherwise the lingual contour of the adjacent teeth as represented in the model will indicate the outlines to be followed by this portion of the crown.

When a bite is necessary, it should be taken in wax, preceding the impression, and should be secured in accordance with the requirements of the impression, and in the manner previously outlined.

**Impression.**

The impression should then be taken in plaster for the reasons already stated, and should always include teeth on each side of the one being crowned, and the *corresponding tooth,* when present.

If the projecting surplus end of the dowel is slightly bent, the cap will be removed with the impression, but in the event of its remaining upon the root, it should be detached and adjusted accurately to position, and securely sustained, if necessary, with a little melted wax. *The interior of the cap and the surface of the dowel should now be covered with a slight film of melted wax to facilitate and admit of its ready removal from the model,* and the impression then varnished and filled.

When the model has been obtained, the bite, if one has been taken, should be adjusted, and the case mounted upon the articulator. The cap may now be easily detached by grasping the end of the dowel with pliers, and the wax then removed from its interior, which will admit of its ready and accurate readjustment, thus facilitating the investment of the crown, and permitting the preservation of the model.

In cases where the remaining natural teeth are quite loose, or support artificial crowns of doubtful stability, the use of small particles of wax packed into the interproximal spaces, and into all undercuts, will be found to be advantageous to the removal of the impression, and to the comfort of the patient.

## Adaptation of Facings.

Previous to the selection and adaptation of the facing, the surplus end of the dowel should be cut off with excising forceps or cutting pliers, leaving it as long as possible so as not to interfere with the adjustment of the facing to its proper position.

As the floor is very thin, however, some little surplus should always be allowed to remain, in order to add strength to the attachment of the dowel.

A long pin facing should now be selected and ground to a *perfect joint* with the cap, along its cervical curvature, and then to meet the requirements of length, contact and characteristics.

**Cervical End.**

When this required and proper adaptation of the cervical end, to the cap, is secured, the *inner* surface of the facing should be thinned down somewhat until sufficient space exists to afford opportunity for securing a close joint between the backing and the cap, with solder.

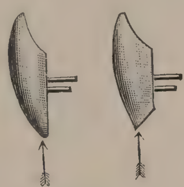


Fig. 128.

**Incisal or Occlusal End.**

The incisal or occlusal end should now be beveled about half-way to the pins, in order that it may present a *smooth, sharp angle,* instead of the usual rounding edge. (Fig. 128.) This becomes necessary as a means of affording a definite edge to which the backing may be subsequently finished.

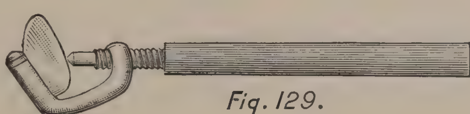


Fig. 129.

The use of the *clamp* designed by Dr. A. Brom Allen, of Chicago (Fig. 129) will be found convenient for holding porcelain facings while grinding.

## Backing of Facing.

The backing of porcelain facings becomes necessary in metal work as a means of supporting them, by affording a surface which will admit of their subsequent attachment with solder.

The requirements in this connection embrace *two* essential features: First, the backing must be *closely* adapted to the porcelain, and, second, it must be sufficiently strong, rigid and unyielding, to protect the porcelain from the strain of mastication

While numerous methods are employed, the following will be found

to be productive of the most certain and accurate results, though possibly somewhat less expeditious than the more simple methods usually observed.

Pure gold, about 34 gauge, cut somewhat larger than the facing, and to extend from cervical to incisal or occlusal edges, should be perforated for the ready reception of the pins, annealed, and carefully burnished to a perfect adaptation.

As it is desirable that the perforations should be properly placed, so as to admit of the free and easy adjustment of the porcelain to position, and to preclude any strain upon the pins in adapting the backing, it should first be observed that the pins *are straight and parallel with each other,* and that this surface of the porcelain is clean and free of wax.

**Adaptation.**

As a means of ascertaining the exact position of the pins, the gold should be laid on a smooth surface and the facing placed over it, pins downward, and sufficient pressure applied with the thumb to make a slight indentation.

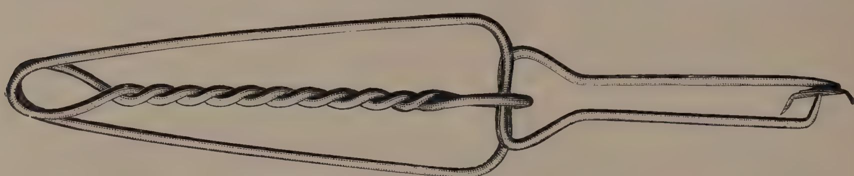


*Fig. 130.*

Or, a thin film of melted wax may be previously placed on the surface to facilitate this, though this is unnecessary because of the softness and thinness of the pure gold.

The perforations may now be made with a punch designed for the purpose, or with a sharp pointed instrument of proper size. The use of the latter possesses the advantage of throwing up a small furrow of metal around the holes, and is preferable.

After annealing and burnishing the gold to a perfect adaptation, the surplus should be trimmed away to closely follow the porcelain on all surfaces *except* the *incisal* or *occlusal,* where a slight projecting edge should be allowed to remain.

While the requirement of *adaptation* has now been complied with in the best and easiest possible manner, that of *strength* is yet to be observed.

**Re-enforcement.**

As the strain upon a facing is generally applied directly upon the end, and then diverted to the point of resistance afforded by the pins, it is necessary that a *uniform re-enforcement* extending over this area should be made.

To best obtain this, and thus combine the requirements of *adaptation and strength,* a second piece of gold, preferably about 22 karat, 29 or 30

gauge, should be perforated, burnished to place, and trimmed *to extend from the pins to the incisal or occlusal end only,* with a corresponding surplus at the latter point.

**Soldering.** The two backings should now be adjusted to position on the facing and reburnished, then removed, placed together with the holes approximating each other, which is facilitated by the furrow of metal produced by being punched with a sharp instrument, and then attached with 20 or 18 karat solder. Small pieces of the latter should be consecutively applied to the joint between the two, presenting toward the cervical end, until the intervening space is completely filled, which may be easily and quickly accomplished by grasping the backings with the soldering pliers, as indicated in Fig. 130, the use of which securely sustains their relation, and precludes any distortion of shape.

The use of an excess of flux should be avoided, and care must be exercised to prevent the solder from filling the perforations, or flowing through to the under side of the backing, and thus destroying the adaptation. The latter may be easily avoided by coating this surface with a solution of whiting, but is usually prevented by the upturned edges surround-

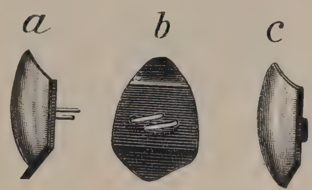


*Fig. 131.*

ing the perforations, which also generally precludes their filling up with solder. The use of small pieces of graphite from an ordinary lead pencil, trimmed to snugly fit, and to project slightly from each side, will also overcome any such tendency.

When the soldering has been completed, the backing should be cleaned in acid, adjusted to position on the facing (Fig. 131, A), and securely retained by bending the pins down close upon it, as indicated in Fig. 131, B. Care must be exercised in bending the pins to catch them with pliers at the *extreme end,* in order to avoid any *stress* or *tension* which might result in immediate or subsequent fracture of the porcelain.

**Finishing.** In finishing, the gold should be trimmed down to close contact with the porcelain around all surfaces. This should be started with a fine file, always carrying it *toward the porcelain;* and completed with disks, to insure the re-

moval of all *overhanging edges,* the presence of which *will invariably cause fractures* of the porcelain along the edges, due to the impingement afforded by the shrinkage and contraction of the metal after soldering.

In trimming away the surplus from the incisal or occlusal portion the file should be held on a *parallel line* with the *labial* or *buccal* aspect of the facing. This leaves the backing its full thickness along this edge, the vulnerable point, when it may be afterward *rounded* nicely until practically invisible, and yet always remain sufficiently long and strong to afford ample protection to the porcelain. (Fig. 131, C.) Much of the artistic effect of the finished crown will depend upon obtaining and preserving a *perfect joint* between the neck of the facing and the cap, and while it is the usual practice to grind this portion of the facing thin, and allow the backing to extend entirely over it, forming a joint with the cap which is subsequently filled with solder, the best results may be secured by filing or grinding away this edge of the backing until the *edge of the facing may be placed in direct contact with the cap.*

This admits of bringing the facing into closer proximity with the gum and of securing a better and more perfect joint between backing and cap, because of the difficulty and uncertainty usually experienced in successfully filling this space with solder.

The use of the clamp previously mentioned may also be found serviceable as a means of holding the facing while finishing the backing.

**Variation in Method.** As the double backing may seem unnecessarily difficult or circuitous, various other methods are employed in preference, but probably with results less certain and accurate.

The re-enforcement of the single pure gold backing may be done with a lower grade of gold, or with solder alone, either preceding its final adaptation to the porcelain, or at the time of soldering the facing to the cap. There is no objection to this procedure if *adequate* re-enforcement is secured, but as gold or solder in fusing flows to a *thin edge,* the *edges* of the backing and particularly the incisal or occlusal, where strength is demanded, are quite naturally the thinnest, and consequently the weakest portions.

This may be overcome somewhat by allowing a slight surplus to extend beyond the porcelain, especially upon the incisal or occlusal end, until after re-enforcing, and then adjusting to position on the facing, and securely attaching and finishing, as indicated. In no event, however, when a single pure gold backing is used, is it advisable to defer the re-enforcement until the final soldering of the crown.

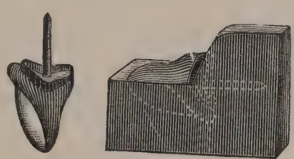
Where a single backing seems indicated or desirable, it should be made of 22 karat gold, about 28 or 30 gauge, but as the burnishing to the

porcelain is thus made more difficult, the additional stiffness and strength is usually obtained at the expense of the adaptation.

The adaptation of heavy single backings may be materially improved by swaging. For this purpose a mould of the lingual surface of the porcelain should be secured in mouldine, and fusible alloy dies obtained, and dies made of ordinary sealing wax, or hard modeling compound are also sometimes used. This consumes even more time, however, than the adaptation of the double backing, and the results are less accurate.

**Use of Platinum.** As porcelain facings are more or less transparent, the presence of a gold backing is frequently objectionable in the blue and lighter shades, because of the yellowish cast imparted to them; hence the placing of a surface of platinum next to the facing is sometimes indicated as a means of preserving the original color, or of effecting the least, or most desirable, change in it.

For this purpose, *platinized gold* is employed, and possesses the advantage of affording a surface of either gold or platinum, as the case may require. A more convenient method, however, is to back up the facing in



a b

Fig. 132.

the usual manner, and then insert a piece of platinum foil (1-1000) over the desired area between facing and backing, just previous to permanently attaching them by bending the pins, and finishing the backing to its proper adaptation; by which means equally good and perhaps quicker results may be obtained.

**Investing.** When the adaptation and finishing of the backing have been completed, the facing should be adjusted to position on the cap, and the proper relation sustained with wax. The crown should now be removed from the model, and the joint between cap and backing well filled with melted wax. This keeps it clean and free of investment material, which is essential to securing a smooth flush joint with solder, and the latter may be facilitated by using *fluxed* wax.

Investment material should now be mixed to a thin plastic consistency, and a sufficient quantity poured upon the surface of a clean piece of paper. The *interior of the cap* should first be *thoroughly filled*, and the

crown then gently forced into the investment, until only the wax remains exposed. After hardening, the surplus should be trimmed to the outlines indicated in Fig. 26, and the wax carefully removed with a small pointed knife-blade, being particular not to loosen the facing in its matrix.

In those cases where the backing has been allowed to extend entirely through between facing and cap some difficulty is occasionally experienced in getting the solder to flow nicely into the joint, and while this may usually be accomplished by properly fluxing and heating the case before attempting to solder, if the proximity of the surfaces is very close the same may be greatly facilitated by placing a small projecting bead of wax around the immediate outside of the joint, before investing (Fig. 132, A). When melted and subsequently absorbed and burned out, this leaves a small space into which the heat becomes concentrated, during the process of soldering, and this aids materially in drawing the solder toward that point.

The cutting of a small opening through the *under* surface of the investment until the joint is *exposed* is also recommended for this purpose, and the same may be easily obtained by extending the bead of wax previously mentioned until it is of proportions sufficient to leave such an opening after its removal. (Fig. 132, B.)

In cases where two or more individual crowns, approximating each other, are being constructed at the same time, they should always be invested *separately,* as it is often quite difficult to solder them, when contained in the same investment, without attaching them together.

**Soldering.**

Previous to heating the case for the purpose of final soldering, and after the investment has been properly trimmed, and all debris removed, liquid flux should be applied to the surface of cap and backing, and worked well down into the joint. If the latter is done after the case is heated, or if powdered flux is used, its penetration to the full depth of the joint is made more doubtful.

The case should now be placed over the flame and *gradually heated until red,* when medium-sized pieces of solder, previously fluxed, should be separately and consecutively applied, and fused, until the joint is first filled, and the desired contour obtains. If the case is *properly heated,* this can be easily and readily accomplished with a small pointed flame from the blowpipe.

When the soldering has been completed, the crown should be allowed to cool slowly by gradually diminishing the size of the flame under it, until it may be turned off entirely. Many prefer to place the work in a cooling oven, or to submerge it into dry plaster until cold, but either procedure is entirely unnecessary.

**Finishing.** After cooling sufficiently, it should be removed from the investment, treated to the acid bath, and then finished with stones and disks in the engine, and subsequently polished on the lathe, when it is ready for mounting.

## Application of Partial Bands.

The application of a partial band encircling only the approximal and lingual surfaces of the root is advocated and employed more or less frequently in the construction of dowel crowns, as a means of avoiding the presence of a labial band, from an esthetic standpoint, and of precluding its possible irritating influence, as a prophylactic measure.

**Comparative Advantages.** A consideration of the comparative advantages leads to the conclusion that, while a band encompassing the entire circumference doubtless adds greater stability to the attachment of the crown, affords a more perfectly hermetical sealing of the end of the root, overcomes the possibility of fracture, may be made practically invisible, and will not necessarily prove a source of irritation, providing that it *fits,* the *partial* band, if well adapted to the *lingual* and *approximal* surfaces, fortifies the attachment against stress in the direction from which stress is exerted, makes it possible to bring the facing into *absolute* and *direct* contact with the tissue, and precludes *any* irritation at this point, or the conspicuous and objectionable appearance of the band in the event of subsequent recession of the tissue.

**Indications.** The indications for the application of this mode of construction are more or less *general,* but depend much upon personal experience and preference, combined with a careful observation of the particular requirements of the case under treatment.

Of special indications, the most favorable are those cases where the root is sufficiently strong to insure permanent support to a crown; or where the labial portion of the root may have been destroyed to the border of the alveolus; where the extreme shortness of the crown, or the thinness and transparency of the tissue surrounding the root, would likely show the presence of the band; where recession of the gums has exposed the labial portion of the root; and where pathological conditions already exist, or the tissue may seem to be particularly susceptible to any possible irritating influence.

## Procedure.

While several methods of securing the desired adaptation are employed, the most positive and accurate results may be obtained by fol-

lowing the same detail of procedure indicated for a circular band, up to and including its fitting, shaping and trimming, as previously outlined.

When the band has been thus fitted and trimmed, a floor of platinum or pure gold, about 34 gauge, should be first simply attached to the lingual *surface* by the *partial fusion* of a small piece of solder. The floor should then be adapted closely to the entire edge of the band, and a precautionary measure observed to prevent their union with solder along that edge of the band which is to be subsequently cut away. To accomplish this, such portion of the joint between floor and band should be filled with a solution of whiting, or occupied by a *thin* piece of *mica* (Fig. 133 A) and the soldering completed around the approximal and lingual surfaces.

The surplus floor metal should be trimmed off on a line with the band, and the labial portion of the latter cut away to the desired point with curved shears, always leaving the edge nicely rounded. (Fig. 133 B.)

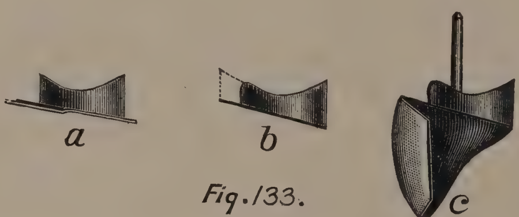


Fig. 133.

When the trimming and finishing of the cap have been completed, it should be adjusted to position on the root, and the projecting labial portion of the floor burnished to a close adaptation to the surface and to the peripheral outline.

The dowel should be fitted and subsequently soldered, and the impression then taken, and the crown completed as already outlined. (Fig. 133 C.)

A method wherein only a *partial* or semi-circular band is fitted to the root instead of a circular one, and where the floor is then attached and adapted by burnishing, is sometimes employed, but while this requires less time, the adaptation is also less accurate.

## Application of Riveted Facings.

Because of the apparent *dread* exhibited by those of limited confidence or experience, towards the process of soldering anything necessarily involving porcelain, for fear of checking it, and of its possible change of color as a result of the application of heat, a method has been devised

whereby the occurrence of either or both of these objectionable features might be entirely and positively eliminated.

The process defers the permanent attachment of the facing to the backing until after the construction and assemblage of all the metal parts of the crown, after which it is then securely anchored by *riveting* the pins.

While there are probably no particular objections to this method, except that the facing is held less rigidly, there are no special advantages apparent because of the *limited* possibilities of checking facings, which have been previously mentioned in connection with "Soldering," and of the fallacy of a probable change in color resulting from the heat of soldering.

That any perceptible change of color is due mainly to the presence of the *backing, and not to the heat,* is proven in porcelain work, where, when necessarily subjected to a very much higher degree, it is even then the rare and exceptional occurrence; and it would also seem that the

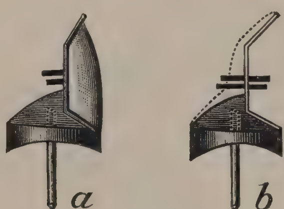



Fig. 134

impact and vibration produced by subsequently riveting the projecting ends of the pins down close upon the backing would be equally as *"hazardous"* a process as that of soldering.

## Procedure.

In the construction of crowns by this method the same general details as previously outlined are observed up to and including the adaptation of the backing.

When this has been accomplished it should be adjusted to position on the facing and finished down as desired, in the usual manner, *except* that the pins are *not* bent to sustain the relation of the two during the process.

Facing and backing together are placed in proper relation to the cap and sealed with a small quantity of hard or adhesive wax in such manner as to securely attach the backing, but to allow the projecting ends of the pins to remain freely exposed. (Fig. 134 A.)

The crown should now be gently removed from the model and the facing carefully detached from the backing.

Small pieces of graphite trimmed from a lead pencil are then closely fitted into the holes in the backing and allowed to project far enough on each side to be securely held by the investment, and to admit of properly forming the lingual contour with solder without being covered over. (Fig. 134 B.)

The remaining incisal portion of the lingual surface of the backing should be covered with wax to keep it clean, and the crown invested. Upon the subsequent removal of the wax the parts should be freely exposed, fluxed, heated and soldered as usual, being careful to note that the ends of the graphite pins are not covered, and that the solder does not penetrate to the under surface of the backing, which is prevented by painting around the pins with whiting.

Fig. 135.

When the soldering has been completed, the graphite may be broken off even with the surfaces and removed from the holes by the use of a sharp pointed instrument or bur of the same diameter.

The facing should now be adjusted to position and the lingual surface of the crown trimmed to allow a free exposure of the projecting ends of the pins. The holes should then be slightly countersunk with a round bur, the crown roughly finished with stones and disks, and the facing finally adjusted for riveting.

**Riveting.** As a means of facilitating the process of riveting, and of lessening the liability of fracturing the porcelain, the riveting forceps designed by Dr. Frank A. Brewer, Sr., may be used to advantage; or the crown may be invested, facing downward, in a base of plaster about an inch in depth (Fig. 135) and the riveting hammer used. In the latter method the projecting ends

of the pins are flattened down over the backing separately, with moderate and well-directed blows from a small riveting hammer. If the crown is properly invested, with a sufficient depth of plaster beneath and supporting the facing, and the whole rests upon a firm seating, this may be done without danger of fracturing the porcelain. The riveted ends are then smoothed down with disks and the crown finished and polished, burnishing the metal up close to the porcelain around the edges.

## Application of Detachable and Replaceable Facings.

The not infrequent presentation of broken facings resulting after the permanent mounting of the crown, combined with the more or less difficult operation of replacing them in a secure and artistic manner, has resulted in the introduction of various means for overcoming the former and simplifying the latter.

Several varieties of detachable and replaceable facings are designed for this purpose, and are applicable to the construction of dowel crowns as well as bridgework, though perhaps more generally so to the latter.

While, as a usual thing, it must be granted that the subsequent fracturing of a porcelain facing is due to one of two causes, i. e., either faulty adaptation of the backing, wherein it affords insufficient strength or inadequate protection, or a total disregard of the requirements of occlusion, the use of a style which is easily replaceable is doubtless an advantage in some instances.

When these common faults in regard to backing the facings are combined with the severe strain to which the porcelain is often subjected in some conditions of occlusion, and the perhaps unnecessarily rough usage sometimes unconsciously accorded them, any practical means of facilitating repair in the event of accident is materially useful.

**Advantages Claimed.**

The advantages claimed by the advocates of this style of facing are: First, that the porcelain is not subjected to the heat of soldering; second: facings may be more easily replaced in the event of becoming fractured; third: the probability of becoming fractured from usage is greatly diminshed because the facing is not so rigidly attached to the metal backing; fourth, the color is not changed.

**Advantages Considered.**

The *first* point made is practically the *weakest*, because the fracturing of a facing during the process of soldering it to any kind of an attachment is inexcusable, and can be invariably attributed to either a lack of skill or a neglect of detail.

The *second* must be regarded as problematical, at least in the manner

in which these facings are ordinarily used, for the reason that it is often impossible to properly adapt any style or kind of facing to the individual case without considerable grinding.

For this reason also the subsequent replacement of even an exact duplicate of the same mould would occasion the necessity for grinding the latter to an accurate fit and adaptation with the stationary backing, and to meet the esthetic requirements, which, irrespective of the manner of attachment, is not usually an easy or simple procedure.

The *third* feature presents the most practical and plausible advantage, because a porcelain facing supported by mechanical means supplemented with an intervening medium such as gutta percha, or even cement, which affords a somewhat cushion-like effect, will withstand greater stress than one held firm and rigid. Hence fracture is, of course, less likely to occur since the facing will yield slightly to stress before breaking.

The *fourth* point of advantage is doubtful, for the reason that any change of color is usually due to excessive heat, or the presence of the backing, as has been previously mentioned.

**Advantages Obtainable.** If the highest advantages are to be obtained in the use of this style of porcelain facing, the adoption of a method suggested and practiced by Dr. F. T. Van Woert and others will be found most practicable. This consists of properly grinding and adapting two or more facings of the same color and mould, as the conditions of occlusion may seem to indicate, for each case at the time of construction. Those not used in completing the crown are then placed in small boxes or other convenient receptacles and labeled with the patient's name. In case of breakage occurring at any subsequent time, a duplicate requiring no fitting or grinding, and which may be readily adjusted to position, is conveniently obtainable.

While such a procedure may involve considerably more work at the time, much may often be saved in the long run, and particularly in difficult cases, where much grinding is necessary.

## Various Designs.

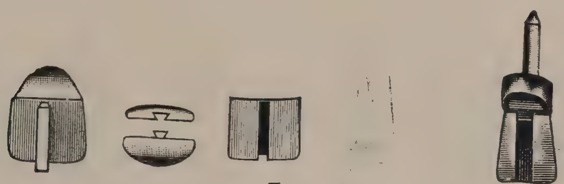
Of the various designs of detachable facings now procurable, the demand has seemingly not justified the adoption of any one special make in preference to the others, nor their extensive manufacture in any great variety of moulds and colors.

**Mason's Facing.** The design of removable or detachable facing devised by Dr. W. L. Mason, of Red Bank, N. Y., is probably the most extensively used. It consists of a heavy gold backing having a triangular *slot* through the center and a facing with a projecting corresponding triangular platinum *bar* extending

longitudinally, through the center, which readily telescopes into the slot in the backing. (Fig. 136 A.)

These facings are obtainable in a fairly good variety of moulds and colors, and the principle of attachment is secure and admits of easy adjustment. The objectionable features lie in the seemingly excessive proportion of platinum baked in the porcelain, which doubtless weakens the latter by dividing it through the center, and in the necessary thickness at the incisal or occlusal end.

**Application.** In the application of this style of facing the cap should be completed as prescribed, and the models obtained and mounted upon the articulator. After the selection of the facing its backing should be adjusted and two facings, *in situ,* ground to fit the cap and to conform to the usual requirements. When the desired adaptation is secured the relation to the cap should be sustained by attaching the backing to it with hard or adhesive wax, and the facing then detached, which is facilitated by a projecting end of the platinum bar



a Fig. 136. b

at the incisal or occlusal edge. Care should be exercised in securing a close relation between the backing and the cap, in order that any penetration of solder through the joint may be precluded, and this may be further prevented by filling the slot and coating backing with whiting. The metal parts should now be invested and soldered, with due attention to the desired lingual contour.

After soldering, the crown should be finished (Fig. 136 B), and the facing then adjusted to position. The projecting end of the platinum bar should now be cut off and the facing attached to the backing with a thick solution of gutta percha in chloroform, after which the edge should be finished up close to the porcelain, and the crown mounted. Or, if desirable, the setting of the facing may be made after the crown has been attached to the root and cement is also some times used.

**Roach's Facing.** A recent design of removable facing has been devised by Dr. F. E. Roach, of Chicago, and for simplicity and strength, combined with accuracy of adaptation, and ready application to either individual crowns or dummies for

bridgework, it presents many favorable features. The design consists of a facing with a dovetail lug extending lingually, which is stamped of one piece of iridio-platinum (Fig. 137 A), and a backing with a slotted diaphragm into which the lug fits accurately (Fig. 137 B).

The *lug* is placed vertically in the body of the facing, and, being entirely surrounded by porcelain, affords to the latter a maximum degree of strength, and is set at an angle which admits of easy adjustment to the backing.

The backing is composed of two parts securely united. The outer portion, which is of pure gold, about 34 gauge, is intended to facilitate ready and accurate adaptation to the porcelain, after grinding; and the central portion, which affords the means of attachment, is in the form of a slotted diaphragm, made of 26 gauge clasp metal.

While the principle of attachment is good and secure, the pliability of the outer backing insures a close adaptation to the surface and edges of the porcelain; the gingival extension admits of a close joint between

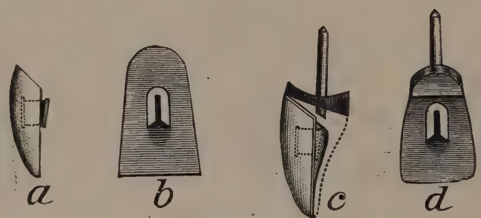



Fig. 137.

facing and cap, and no excess metal exists at the incisal end to offer obstruction to the occlusion, the merits and demerits of these facings, and their possibilities, range of usefulness and general application are at present uncertain, because of the limited supply and selection procurable.

**Application.** After constructing the cap and obtaining models, the facing should be selected and ground to place, closely following the method previously outlined with regard to the cervical and incisal preparation. The backing should then be adjusted to place on the facing and burnished to a close adaptation with the porcelain, after trimming away all unnecessary surplus around the edges.

The two should then be placed in position on the cap and the relation sustained with hard wax (Fig. 137 C), the facing removed and the metal parts invested and soldered (Fig. 137 D).

After finishing the crown the facing should be attached with cement, or gutta percha, and the crown mounted. Because of the extreme thinness

and pliability of the backing surrounding the attachment, this style of facing is also applicable to the construction of the shell or telescope crown with porcelain facing, and to bicuspid and anterior dummies for bridgework.

**Dwight's Facing.** Another design has recently been devised by Dr. W. H. Dwight, of Le Mars, Iowa. This consists of a facing containing a countersunk platinum socket, which engages the arms of a bifurcated spring post, with threaded shank, which is to be previously attached to the backing (Fig. 138 A).

**Application.** In the application of this principle the cap should be constructed as indicated, and the models secured. The facing should then be selected and ground to place with the incisal end properly beveled to afford protection. By *heating the facing* and pressing its labial or buccal surface against a small piece of ordinary sealing wax it may be conveniently handled during the process of adaptation.


Fig. 138.

When the grinding has been completed the spring post should be inserted in the socket of the facing and the end of its projecting shank imprinted in the surface of a piece of pure gold, about 34 gauge, to denote the location of a perforation for its reception.

The perforation should then be made with a punch or small sharp-pointed instrument, and the projecting threaded shank screwed into it until the backing approximates the shoulder of the post. This may be facilitated by leaving the facing attached or by the use of a wrench designed for the purpose. The facing should then be removed (Fig. 138 B), and post and backing permanently attached by the use of a small quantity of solder fused around the line of junction upon the surface to be placed *next to the porcelain,* in order to stiffen and strengthen their union.

The facing is now replaced and the backing burnished and trimmed to a proper adaptation with the porcelain and then placed in position on the cap and the relation sustained with hard wax.

After removing the porcelain the inner surface of the backing should be coated with a solution of whiting and the parts invested, soldered and finished (Fig. 138 C). In permanently attaching the facing to the crown the arms of the post should be expanded until it becomes necessary to use some little pressure in forcing it to place, as they are purposely left slightly contracted, in order to admit of easy adjustment during the process of adaptation.

The facing should then be cemented to place and the crown polished and mounted.

The same principle is also applicable to the replacement of broken facings on crowns otherwise constructed, and will receive subsequent consideration in that connection.

While the details are expeditious and simple, the principle involved in this style of attachment seems weak, from the fact that the mechanical fixation is insecure, and depends much upon the presence of cement for the necessary strength.

**Bryant's Method.**

The method of constructing a replaceable facing, devised and practiced by Dr. Emory A. Bryant, of Washington, D. C., consists of forming a *box* for the accommodation of the pins as a portion of the backing, and is applicable to any size of the ordinary cross-pin flat-back facings, and to the construction of bridgework as well as single crowns.

**Application.**

In the application of this method the facing should be selected and ground to the proper and desired adaptation, after which it should be backed with pure gold or platinum (34 to 36 gauge), as the requirements of construction may indicate.

**Box Method.**

In the box method a pair of Barnard's parallel pliers, modified by the addition of a set screw and by grinding down the ends of the beaks to approximate the diameter of the pins of the facing, as indicated in Fig. 139, are now accurately adjusted to the relation of the pins, and a strip of platinum, 36 gauge, somewhat wider than the length of the pins, is then wrapped around the points of the pliers, forming a box for the reception of the pins.

After soldering the joint, backing and box are adjusted to position on the facing, and their relation marked with a sharp-pointed instrument, after which they are removed and attached by soldering. The two perforations for the pins should now be extended into one by cutting out the metal between them with a fissure bur of about the same diameter (Fig. 140 A).

This should then be readjusted to position on the facing, and the inner

edge of the box, and the ends of the pins trimmed to approximate, and until the projection offers no obstruction to the desired contour or occlusion. A cover of 22 karat gold, about 28 gauge, somewhat larger than the box, is soldered to this edge from the outside, and subsequently trimmed until all surplus is removed, which completes the construction of the backing. (Fig. 140 B.)

The facing should be prepared by slightly serrating the surfaces of the pins which present toward each other, and then filling the space between them with soft solder, using enough to fill it at least equal to the length and thickness of the pins.

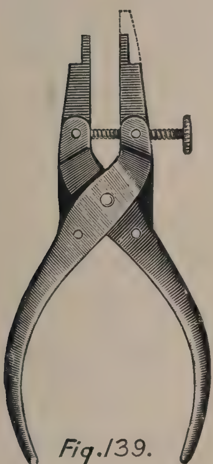


Fig. 139.

This may be easily done by first fluxing the pins with soft solder flux, placing the soft solder or fusible alloy in position, and carefully directing the flame upon the porcelain, until it takes hold of the pins, after which it should be quickly plunged into cold water to preclude an expansion of the pins, which might cause fracture of the porcelain. Or the facing may be placed on a charcoal block or asbestos pad, pins upward,

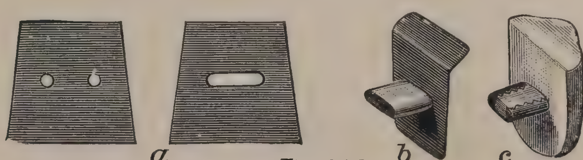



Fig. 140.

and the solder fused by carefully directing a small flame upon the porcelain.

This extension of soft solder should be filed down even with the pins on all surfaces (Fig. 140 C), except that the extreme end should remain a shade heavier or thicker, to facilitate the subsequent attachment to the backing with cement.

Facing and backing should be adjusted, placed in proper relation with the cap and temporarily attached with hard wax. The facing should then be removed and the box filled with moistened whiting, and a staple of German silver or iron wire inserted, with the ends projecting about one-quarter of an inch. This prevents the solder from penetrating the interior of the box, and precludes any change in the relation of box and backing during the process of soldering. The parts should be invested, soldered and finished as usual and the facing then mounted with cement.

**Tube Method.** A similar method involves the like adaptation of a *separate tube* to each individual pin, but as this entails much more work, possesses less strength and affords less opportunities for replacing the facing in case of accident, it has been almost entirely superseded by the former procedure.

The merit possessed by these methods lies in the facility with which a replaceable facing and its attachment may be constructed, and the main advantage in their use may be attributed to the fact that the facing is not held so unyieldingly rigid as if soldered.

**Davis Crowns.** Among other advantages possessed by the Davis crown is also that of being easily replaceable in case of breakage, but as this style of crown in the various phases of its application will receive due and separate consideration, further reference to it in this connection will be deferred.

## Application to Bicuspids and Molars.

The band and dowel style of construction is applicable to the restoration of the crowns of bicuspids and molars as well as to the anterior teeth, but is more generally indicated and more extensively employed upon bicuspids than upon molars.

**Indications.** While it is especially indicated in *porcelain work,* where the root is necessarily and purposely trimmed to approximate the gingival line, it is also indicated in combination with gold, in order that the work may more closely approach the highest esthetic requirements. In this connection, and in the absence of facilities for doing porcelain work, a facing, or saddleback or rubber tooth may be used with artistic results, and particularly where the shortness of the root demands the employment of a dowel attachment, in preference to restoring its coronal proportions with amalgam, and using a shell or telescope crown.

**Bicuspids.** The application is more generally indicated and more practical on the bicuspids, because of the necessity for observing higher artistic possibilities, and of the objection to placing gold crowns upon these teeth.

**Molars.** In the restoration of molars, however, the indications are not so general, and the range of application is more limited, for the reasons that such crowns are usually beyond the range of vision, at least to an extent which greatly diminishes the esthetic requirements; that they are subjected to more vigorous strain in the act of mastication, and that a telescope attachment to a projecting end of the root doubtless affords greater strength and

more permanent stability than is usually obtained by cutting the remaining root down to the gingival line and using a dowel attachment.

It is claimed by some, however, that the preparation of a *short* root and the subsequent adaptation of a *narrow* band, with accuracy, is so facilitated as to present advantageous features, as compared with the more extensive preparation of the remaining coronal proportions of the root for the shell or telescope crown.

Yet such a claim reverts to the manner of the execution of the necessary details, and as they must be carefully and skilfully observed in *either instance,* the advantage seems more hypothetical than practical, and the judicious preservation of tooth structure combined with the stability of attachment as applied particularly to the molar teeth, for the reasons mentioned, should precede a consideration of *facility and possible advantages* in the construction.

## Procedure.

In the construction of this style of crown, in combination with gold, *two* more or less practicable methods are employed, and they differ only in the style of porcelain facing or tooth used. The cap should be completed as though for an anterior crown, as described, and the dowel fitted and soldered.

**Reenforced Cap.** Where a heavier and stronger cap than will be afforded by the thickness of the band is indicated or desirable, the same may be obtained by allowing the floor to extend or project about $^1/_{32}$ of an inch from the band, and then filling in until flush and smooth with 22 or 20 karat solder. This will result in a cap possessing good adaptation, a maximum degree of strength and a minimum tendency to cause irritation, such as is frequently indicated in the restoration of bicuspid crowns.

**Use of Two Dowels.** If the use of two dowels should become necessary to insure sufficient stability, care should be observed to have them inserted at such an angle as to pass into the root readily, and yet project through the floor of the cap at a point at which they will offer little, if any, obstruction to the proper adjustment of the facing. While the surplus ends may be cut away reasonably close to the floor *after soldering,* the longer they may be allowed to remain the greater the strength of their attachment to the crown.

**Bite and Impression.** The bite and impression should follow in the usual manner, and the models then be obtained and mounted upon the articulator.

## Use of Flat-Back Facing.

The method perhaps most usually employed involves the use of a flat-back facing and gold cusps, and while this style of construction possesses the advantage of strength, it also presents the objectionable feature of the presence of an occlusal surface of gold.

**Facing.** The facing should be selected and ground to position on the cap, and the occlusal end then ground to allow for the presence of the cusp, and properly *beveled,* as indicated. It should then be backed up with a single backing of pure gold, about 34 gauge, which should be closely finished down to the edges at all points, *except* on the *occlusal,* where a slight projecting surplus should remain.

**Cusps.** Facing and backing should now be placed in position on the cap and sustained with hard wax (Fig. 141 A), while the cusps are being formed and fitted by whatever method selected.

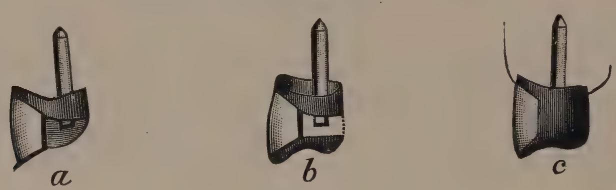



Fig. 141.

These may be accurately obtained by allowing one or both of the pins to project away from the backing, pouring soft plaster into the space and up against them, and closing the articulator, and then subsequently carving them and securing dies in the manner already outlined. The pins are allowed to project as a means of securely sustaining the plaster during the process. Or the cusps may be obtained from any of the die and die-plate systems.

**Adaptation.** After swaging, the buccal portion of the gold should be cut away to the occlusal angle on a plane which will admit of approximating it with the edge of the facing and backing. This will leave only the thicknesses of the gold forming the cusp and the backing along the occlusal edge, but the same will afford ample protection to the porcelain, and admits of a more esthetic result.

After thus trimming the cusp to adaptation with the porcelain the two should be adjusted to the cap with wax and adapted to the articulation and occlusion. (Fig. 141 B.)

While all soldering may be done at the time of uniting cusp, facing and cap, it is usually best to remove the *cusp* and *facing* in their proper relation, and previously invest and attach them with a sufficient quantity of 20 karat solder to effect union and fill the lingual portion of the cusps.

To preclude the checking of the facing along the edge, as a result of the impingement of the cusps occasioned by the shrinkage of the solder, a *slight space* should be allowed between the backing and cusps, and this filled with wax to prevent the investment material from running in.

**Approximal Restoration.** When the parts are securely sustained with wax enough should be further added to form the proper approximal contour to secure a restoration of contact, and a small piece of pure gold, about 36 gauge, should then be *adapted* or burnished to each *approximal* side of the crown, extending from cusp to cap, and held in place with the wax. This forms a matrix which facilitates soldering and gives the desired approximal contour, but should not extend over the lingual portion of the wax, as the solder must be subsequently added from this point.

Foil gold, No. 60 or 120, may also be used for the same purpose, if desired.

**Investing.** The crown should be invested with a slight covering over and up to the edges of the pure gold matrices to hold them in place, but with the lingual surface freely exposed. When the investment has been properly trimmed, the wax should be carefully picked out and the remainder removed by pouring boiling water upon it, and the parts then fluxed and heated.

**Soldering.** The soldering should be done by the consecutive application of small pieces of 18 karat solder, of a size suitable to be readily dropped into the opening. Small balls of scrap gold and silver are sometimes used to aid in filling in when the space is of considerable size, and the use of the same facilitates the procedure and lessens the extent of shrinkage which would take place in the use of solder alone. The use of balls of German silver or copper is also permissible if they are well and completely covered over with the gold solder.

In finishing, care should be exercised to preserve the approximal contour, in order that contact may be properly restored and the crown then polished and mounted. (Fig. 141 C.)

These crowns are sometimes constructed without cusps, but such practice is to be condemned, except in rare instances on first bicuspids, because the usefulness of any crown is usually equal in importance to cosmetic effect.

## Use of Saddle-Back Teeth.

A variation of method consists in employing the so-called saddle-back tooth instead of the facing, and while this style of construction possesses the advantage of presenting an occlusal surface of porcelain, and thus avoiding any display of gold, the more esthetic result is probably obtained at the expense of strength, as the thin lingual portion of such porcelain teeth is usually inherently weak and more or less easily broken. Where the stress of occlusion is light, however, they may often be used to good advantage.

**Procedure.** In their application a selection should be made which possesses as broad a neck as will be required to make a perfect joint with the cap, and which will restore the contact with adjacent teeth.

It should then be ground to meet these requirements, and to properly occlude and articulate, after which a single backing of about 34 gauge pure gold should be well adapted, attached by bending the pins, and trimmed to closely follow the edges of the porcelain without overhanging. (Fig. 142 A.)

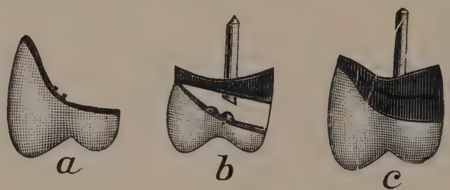



*Fig. 142.*

The proper relation to the cap should now be obtained (Fig. 142 B) and securely sustained with hard wax, and the crown invested in such manner as to have the porcelain covered, but to leave the backing freely exposed.

In soldering, a sufficient quantity of 18 karat solder (in addition to the use of balls of metal, if desirable), to afford ample and adequate contour of the approximal and lingual surfaces, should be used. Fig. 142 C illustrates the finished crown.

**Use of Vulcanite Teeth.** An ordinary vulcanite tooth may also be employed in similar manner, and in crowns of considerable length sometimes to even better advantage, because of possessing more strength in the lingual cusp, due to the greater body of porcelain surrounding the pins.

In their use the heads of the pins should be compressed between the beaks of pliers, or cut off, and the lingual surface ground smooth to facilitate the adaptation of the backing and the above procedure observed.

## Application of Removable Crowns.

Previous to the modern methods of successfully treating chronic alveolar abscesses, the construction of crowns which could be temporarily removed from their attachment to the root and easily replaced was advocated and practiced as a means of permitting the necessary therapeutic treatment of roots so affected.

At the present time, however, such practice, for this purpose, has become almost, if not entirely, obsolete, and the application of such crowns is, in consequence, indicated only in the construction of *removable bridge-work;* hence, their indications and usefulness, together with the various methods of construction employed, will be subsequently considered.

## Application to Irregularities.

Since some cases and forms of irregularities are not always amenable to the usual process of treatment for their correction, because of the age of the patient, the poor character of the teeth, their position in the arch, or other physiological or pathological reasons, it sometimes becomes warrantable to sacrifice the natural crowns and effect artificial substitution, which will relieve the disfigurement thus occasioned.

As the radical or injudicious destruction of the natural crowns of teeth must be regarded as presenting a serious aspect, and particularly when involving the anterior teeth, where they are necessarily sacrificed to the gingival line, a careful study of the existing conditions must be made, in order that it may be wisely determined that such a procedure is justifiable.

**Indications.** The two general classes indicating such treatment as a means of improving both usefulness and cosmetic effect, are those resulting from *malposition,* and a diminution of the normal space caused by *gravitation.*

## Malposition.

Cases are not uncommon wherein the malposition of one or more teeth, as previously indicated in Fig. 31, may be best corrected by the application of artificial crowns, but the achievement of successfully artistic and hygienic results in such instances will depend much upon a close observation of the necessary details of construction.

**Construction.** In the construction of crowns for such extreme cases, as is illustrated in Fig. 143, the cap and dowel should be adapted to the root, as usual, and the bite and impression taken and models secured.

**Extension for Support of Facing.**

An extension from the cap which will afford a close adaptation to the tissue, and a practically unyielding support to the facing when placed in its proper position of alignment, should then be made by burnishing a piece of pure gold, 34 to 36 gauge, to the model.

When the desired shape and conformation have been obtained, the extension should then be *imbedded into* the model at least equal to its thickness by first marking the outline and then uniformly scraping the surface.

The cap should then be detached from the model and both cap and extension again placed in position and their relation sustained with hard wax.

The parts should now be removed and invested, and subsequently united with adequate re-enforcement. This can be best accomplished by trimming a piece of clasp metal or 22 karat plate, 28 to 30 gauge, of

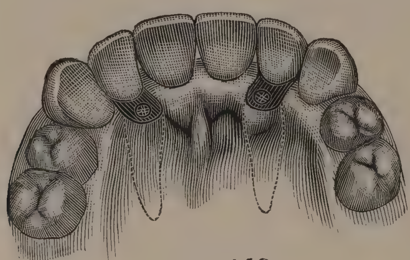


Fig. 143.

proper size to rest upon the cap and cover the extension, and then uniting the whole with 20 karat solder.

This should then be replaced in position on the model, and the crown completed in the usual manner.

**Hygienic Considerations.**

The hygienic qualities possessed by crowns so constructed depend, of course, upon the adaptation of the extension and facing to the tissues upon which they rest; but the burnishing (or swaging, if more desirable) of the extension admits of a close conformation, and the scraping of the surface of the model beneath it and the neck of the facing so increases the bearing upon the tissue as to usually result in an adaptation of the finished crown which will preclude the lodgment and accumulation of debris.

## Diminution of Normal Space.

A condition which is a phase of malposition caused by the natural tendency of teeth to gravitate toward an unoccupied space in the arch

is illustrated in Fig. 144, where, from the extensive destruction of the natural crown by caries, the adjacent teeth have moved together, until the space formerly existing in the normal relation is much reduced.

In such conditions, when involving any of the ten anterior teeth, the application of an artificial crown of *adequate and proportionate* size would be impossible, of course, unless sufficient accommodation be previously gained by *separating the teeth,* and such a procedure is indicated, and becomes essentially necessary, if the highest artistic results are to be obtained.

**Separation of Teeth.** In separating the teeth in such instances the application of a simple regulating appliance may become necessary if any great deal of space is to be gained, and when the desired space has been obtained it may be preserved during the construction of the crown by wedging with a small piece of wood, or by *tightly* packing with gutta percha or temporary stopping during intervals between sittings.

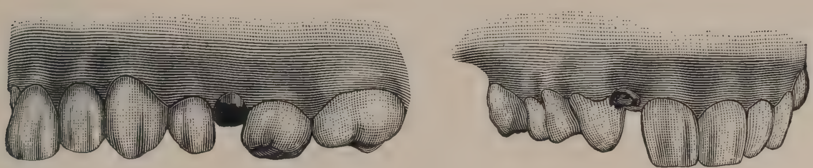


Fig. 144.

Sufficient separation may often be secured in a more simple manner by trimming and closely fitting a wedge of soft wood, *previously compressed* in a small bench-vise, into the space. If the wood is properly trimmed to follow the outlines of the adjacent teeth, so that it may be worn with some degree of comfort, and then *tightly* fitted into the space, having the surfaces approximating the adjacent teeth slightly concaved to hold it in position, and the grain placed parallel with the long axis of the tooth, the absorption of moisture will usually produce an expansion sufficient to create the space desired. This may also be increased somewhat by the use of an intervening layer of cotton or tape when necessary.

## Application of the Intradental Band.

For the purpose of avoiding the necessary peripheral preparation of the root and the possible irritating influence of a band, and at the same time securing the additional stability afforded by the latter to the attachment of a dowel crown, the *intradental* band has been devised.

The principle involved is similar to that of the original Büttner crown in which the *periphery* of the root was trephined so as to form a seat

for the accommodation of the band. In the application of the intradental band, however, a *groove* is trephined into the root midway between the pulp canal and the periphery, and a band subsequently fitted into the groove.

The design was probably originally suggested and patented by Dr. Moses Rynear, of New York, in 1886, but subsequent patents have been obtained on modifications of this by Dr. J. Leon Williams, of London, and Dr. B. J. Cigrand, of Chicago, in both of which the principle is the same, but the application and details differ somewhat.

While the advantages claimed by the advocates for this mode of construction are doubtless desirable, they are obtained at the expense of the integrity of the basal portion of the root, and for this reason are indicated only on large, strong roots, entirely free from decay, and will probably never become more generally applicable.

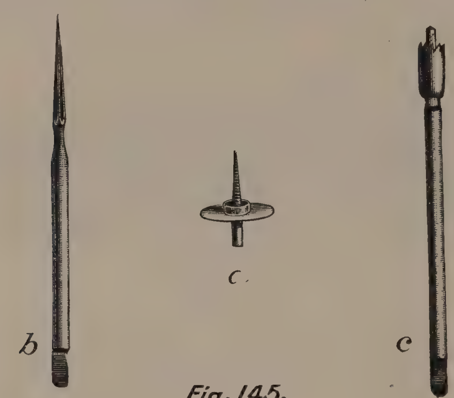


Fig. 145.

Fig. 146.

**Williams's Method.** The design and method devised and employed by Dr. Williams consists of a series of ready-made platinum caps and dowels in graded sizes, together with suitable trephines and root canal drills.

**Application.** In the application of this style of crown the root is prepared as usual for a dowel crown, without a band. A cap (Fig. 145 A) of suitable and proportionate size is then selected from the series, and the trephine and drill of corresponding size selected.

The canal is first enlarged with the drill (Fig. 145 B) to accommodate the dowel, and the trephine then used to cut the groove for the reception of the band, and the proper relation between the two is secured by the guide post in the center of the trephine. (Fig. 145 C.)

When the cap has been thus closely adapted to the canal and groove,

the surplus floor, which is about 34 to 36 gauge, should be trimmed to follow the peripheral outline, and burnished to the desired adaptation with the entire surface of the root.

The bite and impression should then be taken and the crown completed in the usual manner and mounted with cement.

The facility with which these ready-made caps may be secured and adapted to the root in the use of this method expedites the detail of construction, but the band seems too thin and narrow and the dowel too slender to afford adequate strength and stability to a crown of average requirements.

**Cigrand's Method.** The method devised by Dr. Cigrand constitutes making the band and cap and adjusting the dowel, and the necessary outfit consists of two sizes of trephines and a measurement gauge, as previously illustrated in a consideration of the treatment of *"fractured roots."*

**Application.** In the application of this method the root is prepared as indicated, and the groove cut as deep as practicable with the trephine of proportionate size. The band is then cut the exact length indicated by the measurement guide for the size trephine used, about one-eighth of an inch wide and of 30 gauge gold, 22 karat, or platinum, made in circular form, the edges abutted, and soldered with a very small bit of solder.

It should then be fitted over the end of the measurement mandrel to give it the proper form, and adjusted to position in the groove by gently forcing to place.

The surplus end extending from the root should be allowed to remain to facilitate removal and filed smooth on a parallel line with the surface of the root. It should then be removed and soldered to a floor of pure gold or platinum, 34 gauge, somewhat larger than necessary, with a minimum of solder.

The edge of the band previously fitted into the groove should now be trimmed away until the floor rests firmly against the root, when in position, after which it should be trimmed and burnished to the proper adaptation.

The canal should now be prepared, the dowel fitted, and then soldered to the cap, as indicated, and the crown completed in the usual manner.

The completed crown and the relation it should bear to the root in both of these methods is illustrated in Fig. 146.

## Repairing and Removing.

Because of the presence of porcelain, and the consequent more or less frequent occurrence of fractured facings as a result of accident, in-

adequate protection, or faulty articulation and occlusion, as well as for the purpose of replacement or substitution, it often becomes necessary to repair this style of crown, or to remove it from its attachment to the root.

## Repairing.

The presentation of fractured or broken facings on crowns and bridges constitutes a large per cent of the failures requiring such attention, and where the work remains otherwise in good condition, and is secure in its attachment, repair may be effected in an artistic manner by replacing the facings without removing the piece.

**Replacement of Facings.**

In the replacement of facings, several good and reliable methods are employed, but a selection of the best or most desirable one will depend much upon the construction of the work and the requirements of the case, as well as the individual preference of the operator.

When such a procedure is indicated, where the work has been constructed by the ordinary method, all remaining particles of porcelain surrounding the pins should first be broken and removed. This can be quite easily accomplished with excising forceps, cutting pliers or chisels, after which the projecting pins should be cut away and ground down flush and even with the surface of the backing, with a sharp, round, or oval, plain, or plug-finishing bur.

**Usual Method.**

The method usually and, perhaps, most commonly employed consists of securing the attachment of the replaced facing by simply bending or clinching the pins upon the lingual surface of the backing.

**Procedure.**

In this procedure a facing of the required size, shape and color should be selected, and the backing then properly perforated to admit of its adjustment. The accurate position of the perforations may be easily ascertained, and designated, by first coating the surface of the backing with a *thin* film of melted wax, and then pressing the ends of the pins into it, after noting that they have been made *parallel with each other,* and that the facing is held in its proper relation to the backing and adjacent teeth or facings.

When the exact location has been thus, or otherwise, designated, the perforations may be made with a small spear-pointed drill, and subsequently enlarged to the proper proportions to receive the pins with a round or fissure bur, or twist drill, of corresponding diameter. While they should be large enough to readily admit of the reception of the pins,

the fit should be sufficiently close to render the attachment secure, and preclude the subsequent loosening of the facing.

The facing should be then adjusted to position and ground to fit the backing, and to meet the requirements of length, occlusion and alignment; and this may often be somewhat facilitated by bending the incisal or occlusal edge of the backing, with pliers, until a more favorable shape presents.

When the adaptation has been completed, it should be noted that the pins extend through upon the lingual surface sufficiently far to admit of securing a firm attachment by bending their surplus ends; and in the event of this being prevented by the thickness of the backing, its lingual surface should be previously ground down with small carborundum stones, or burs, until such security is made possible.

The surfaces of the facing and backing should then be thoroughly cleaned, slightly roughened and dried with alcohol or chloroform, when

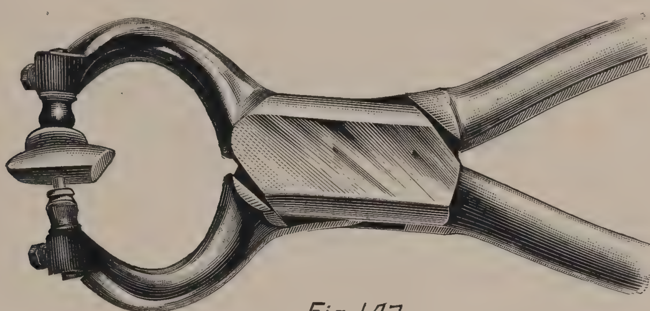


Fig. 147.

the backing should be covered with cement mixed fairly stiff, and the facing adjusted to position, where it should be held *firmly* while the ends of the pins are being bent over upon the backing with pliers.

Moisture should then be excluded from the cement until it has thoroughly crystallized, when the edge of the backing should be finished down close to the porcelain, with disks, and the pins *flattened* with small stones until presenting a more or less smooth and continuous contact with the backing. The latter may usually be done to the best advantage, and with the least danger of fracturing the cement, at a subsequent sitting.

## Brewer's Method.

The above procedure is much simplified and greatly facilitated by the use of a pair of *"riveting forceps,"* designed for the purpose of riveting the ends of the pins down close upon the backing, by Dr. Frank A. Brewer, Sr., of King City, Cal. (Fig. 147.)

One beak of these forceps presents a corrugated soft rubber pad, on an adjustable joint, which admits of its close adaptation to the facing at any angle or position, while the other presents a small concave steel point, also likewise adjustable, which engages the end of the pin.

**Application.** In the application of this method of attaching the facing, the perforations should be made and the facing adapted, as indicated, and then the ends of the pins or the backing should be sacrificed until the former project *only* about 1/32 of an inch beyond the surface of the latter.

The lingual surface of the perforations should now be somewhat countersunk with a round bur of proper size used in a right angle handpiece.

When the facing has been well adapted, it should be placed in position with, or without, cement, and the forceps then adjusted, when a slight pressure upon the handles applied during a rotary or swinging movement of the arm will effect an expansion of the diameter, and a compression of the heads of the pins, until a very secure and finished attachment results, with little or no danger of fracturing the porcelain.

## Underwood's and Mitchell's Method.

The method advocated by Dr. C. J. Underwood, of Elgin, Ill., which in similar detail has also been employed for a number of years by Dr. Wm. Mitchell, of London, England, is also valuable and useful, and is particularly applicable to those cases where the old backing was originally, or has been worn down until, too short to afford the proper protection to the porcelain along the incisal or occlusal edge.

This method consists of adapting a duplicate backing to the lingual surface of the old backing, and then attaching it to the pins of the facing with solder, and, wherever the occlusion will admit, its application may be made with very artistic results, and with a maximum of strnegth.

**Application.** In the procedure incident to the application of this method, the remaining porcelain and projecting ends of the pins should be removed from the old backing, and *slots* or *grooves* sufficiently wide to accommodate the pins of the new facing and extending from the incisal or occlusal end toward the cervical to a point which will admit of its proper adjustment, should be made with a cross-cut or plain fissure bur. (Fig. 148 A.)

The location of these grooves may be accurately designated, as previously indicated, and the bur used should be of a diameter as similar to that of the pins as possible.

The facing selected is then ground to the required and desired adaptation, and afterward backed up with pure gold, about 34 gauge. This

should be well adapted to the incisal or occlusal end of the facing, and trimmed to closely follow its outlines. The *cervical* edge of the backing should be then drawn away from its contact with the porcelain toward the extreme ends of the pins, so as to *straddle* or pass to the lingual surface of the old backing.

Facing and backing should be then adjusted to position on the crown or bridge, and the latter burnished to a close conformation with the lingual surface of the old backing, which, if too thick to allow the pins to project slightly through the new backing, should be ground until admitting of same. (Fig. 148 B.)

While it is best to secure this adaptation directly in the mouth, it may also be accomplished with reasonable accuracy by taking an impression of the crown and adjacent teeth, after the grooves have been cut, with gutta percha, and obtaining from it a *fusible metal* working model for the purpose.

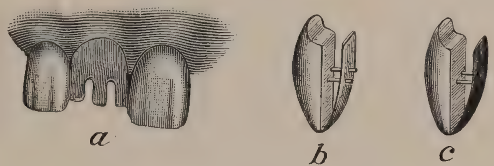


Fig. 148.

The adaptation should then be sustained by the use of wax or temporary stopping, and the facing and backing gently detached, and invested with sufficient care to insure the thorough penetration of the investment material into the intervening space between the two.

The relation should now be permanently sustained by soldering the backing to the exposed ends of the pins, and then re-enforcing it as much as the occlusion will admit, after which it should be finished and polished (Fig. 148 C.) and then mounted with cement.

While the detail of this method is necessarily somewhat circuitous, the procedure affords a most secure and finished result.

## Dwight's Method.

Dwight's method, which has been previously mentioned and illustrated in connection with replaceable and detachable facings, is also applicable to the repair of work where the ordinary two-pin facing has been used.

**Application.** When the remaining porcelain and projecting ends of the pins have been removed, a facing of this particular style should be selected and ground to place, in which the procedure is facilitated because of the absence of any pins.

After the proper adaptation has been secured, the "finder," which is included among the necessary instruments for doing this special work, and consists simply of a base or shank which fits into the socket in the facing, and tapers to a central point, should be adjusted to position. (Fig. 149 A.)

This affords a means of designating the exact location for a single perforation in the old backing, by applying sufficient pressure, or by the use of a thin film of wax, with the facing held in its proper relation.


Fig. 149.

A *small* perforation should first be made at this point with a drill or round bur, and this then suitably enlarged with a twist drill, and subsequently threaded with a tap, both of which are also included in the outfit. (Fig. 149 B.)

The threaded shank of the "*attachment*" should be now adjusted to the "holder" (Fig. 149 C.), and screwed into place until its base rests firmly against the backing, and the spring ends are brought into proper position to engage the facing. If the latter is impossible at the first trial, the attachment should be unscrewed and removed, and the backing immediately surrounding the perforation ground away.

By this means the threaded area may be gradually diminished until the required relation is obtained, after securing which the projecting end of the attachment upon the lingual surface is ground down even with the backing, and the facing then mounted with cement.

## Bryant's Method.

Among the most ingenious methods used in replacing facings is the one devised by Dr. Emory A. Bryant, of Washington, D. C. This consists of countersinking the old backing from the lingual surface; then threading the pins of the facing, and attaching it to the backing by means of a corresponding countersunk nut.

The latter are procurable in ready-made form, as are also the necessary instruments for doing the work, and while this method affords a secure means of attachment, the detail is somewhat exacting and requires considerable time.

It is perhaps more generally applicable to replacing facings on bicuspids, or even molars, in bridgework, than to the anterior teeth, because the strength of the attachment increases, of course, in proportion to the thickness of the backing, which in this particular region is necessarily governed by the occlusion, yet it may often be applied here.

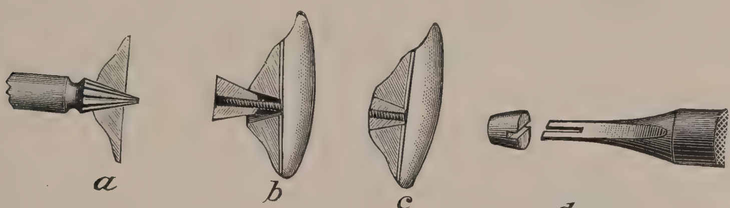



Fig. 150.

**Application.** In the application of this method, the remaining porcelain, and projecting ends of the pins, should be removed, the new facing selected, and the backing accurately perforated for the reception of the pins, as previously indicated; after which the facing should be ground to the required adaptation.

The perforations in the backing are now countersunk from the lingual surface with the countersinking reamer in right angle handpiece, until they are suitably enlarged to receive the small end of the nut and admit of bringing it flush and even with the labial or buccal surface of the backing (Fig. 150 A.), *care being observed that it shall not protrude to the least extent.*

When this has been accomplished, the pins of the facing should be threaded, first with the large size tool, or screw-plate, and finally with the smaller one; in this procedure care must be exercised to prevent twisting off the pins. The use of a little oil will preclude this and facilitate the work.

The nuts are made of a well alloyed gold, corresponding in size with the reamer, and are *tapped* to fit the threaded pins of the facing, to each of which the respective nuts should be first adjusted to place, before the permanent attachment of the facing to the backing is made.

The backing should then be coated with cement, the facing placed in position and the nuts adjusted to the pins (Fig. 150 B) (which may be facilitated by a "holder"), and *alternately* screwed to place with the wrench, avoiding undue force, until both are firmly fixed in their proper relation and the attachment is secure.

The projecting ends of the nuts and pins should now be ground down, with small carborundum stones, until smooth and continuous with the backing, and the surface subsequently polished with disks. (Fig. 150 C.)

The nuts, and a wrench, suitable for their adjustment, are illustrated in Fig. 150 D.

**Replacing Bicuspid on Molar Facings.**

The replacement of facings on bicuspids and molars, although perhaps most generally confined to bridgework, will be also considered in this connection. This is usually a somewhat more difficult procedure, because of the increased thickness of the gold forming the cusps and lingual contour, and surrounding the area where the attachment must be secured, which usually precludes a projection of the ends of the pins.

Where it may not be desirable to employ the Bryant method, or where the same may seem contraindicated, or be impracticable, the most simple and commonly applied procedure is to cut a countersunk aperture in the old backing with drills and burs, of proportions sufficiently large to admit and accommodate both pins of an ordinary facing.

The facing should then be selected and ground to the required adaptation, and the ends of the pins bent somewhat diverging from each other, or to present short sharp right angle turns, which may be passed into the aperture when the facing is slightly inverted, and which will hook over its edge upon bringing the facing into proper position.

This will increase the integrity and strength of the subsequent attachment with cement, and the same may be further facilitated by serrating or roughening the surface of the backing with a sharp wheel or inverted cone bur.

Facing and backing should now be thoroughly dried, and the mounting made with cement mixed fairly thick, and with an observation of the previously mentioned details in this connection, reasonably permanent results may be obtained.

Where adequate mechanical retention is possible, plastic amalgam

may often be used to good advantage, and is sometimes preferable to cement.

**Replacement of Facing and Backing.** In those cases where the old backing has been almost, or entirely, destroyed, so that sufficient opportunity for securing adequate anchorage for a new facing, by any of these methods, is doubtful; or where the cap and dowel have become detached from the root, or may be removed without mutilation or destruction, repair can *almost invariably* be *best* effected by cutting the remaining backing off close to the base of the cap with a fine saw, excising forceps, carborundum stones or files, and attaching the facing and its new backing by *investing and soldering* in the usual manner.

The mechanical saw (Fig. 151) will usually be found best adapted to such purpose, and is an indispensable device to a well-equiped laboratory.

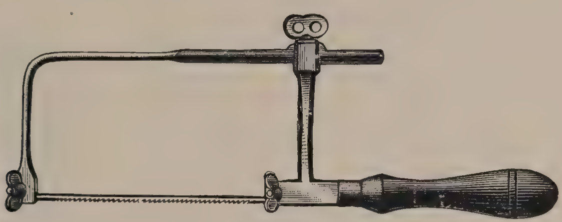


*Fig. 151.*

This procedure will afford opportunity for securing the strongest and most artistic results wherever the adaptation between cap and root is sufficiently good to warrant the use of the old cap, and where this is doubtful, a new crown should be constructed throughout.

**Procedure.** In such instances the procedure should consist in first removing the remaining cement from the interior of the cap, with burs, and then thoroughly cleansing in acid. The dowel should now be grasped firmly in a jeweler's pin-vise (Fig. 152) (which is a most useful instrument in this work), and the backing removed up sufficiently close to the base of the crown to offer no obstruction to the proper adjustment of the facing.

The cap should be then placed in position upon the root, and the usual "bite" and impression taken, when the repair can be made upon the models in accordance with the usual method of construction from this point on.

## Removing.

The removal of this style of crown may often become necessary for the purpose of replacement or substitution, and while the procedure may be found somewhat difficult in those cases where the attachment remains secure, it may be effected by one or the other of the following methods:


Fig. 152.

**Use of Excising Forceps.**

The easiest and most convenient method, whenever applicable, is to first crush and remove the facing if present, and then grasp the remaining backing up close to the base of the crown, where it is thickest, with the beaks of a pair of excising forceps (Fig. 153) (which is also a most useful instrument), and then gradually and slowly fracture the cement and destroy the integrity of the attachment, by exerting a slight pressure upon the handles and a *lateral* or *rotary* movement upon the crown.

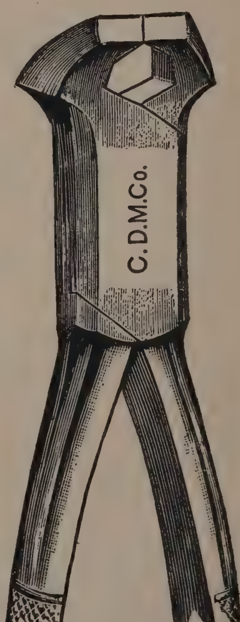



Fig. 153.

The power of the lever, in this application, will usually result in the ready detachment of the crown from the root, but force should be applied slowly and with exteeme care, in order to prevent injury to the peridental membrane, or the removal of the root.

In the event of *loosening* the root, because of its instability, or of the strength and integrity of the attachment of the crown, *which will always cause a slight gingival hemorrhage,* this procedure should be at once discontinued before injury has resulted, and another one requiring less force will be demanded.

**Separating Cap and Dowel.**

When the above method seems contraindicated, or proves ineffective, or where the backing has been previously destroyed until no opportunity is afforded for its application, the removal may be facilitated and made easy and devoid of danger, by first separating the cap from the dowel.

This may be done by drilling through the base of the crown at a point *approximating* the *periphery* of the *dowel,* until the root has been reached, with a small drill or round bur, and then severing the cap from the dowel with burs of a larger size.

When this has been accomplished, if it is desirable to utilize the cap again, it should be worked loose and lifted off with pliers; but if no further use is to be made of it, the procedure may be facilitated by destroying the continuity of the band with excising or crown slitting forceps, or a small bur.

The remaining dowel should then be removed by cutting away the surrounding cement with *very small* round burs, until it may be gripped with strong small-pointed pliers, and the entire length removed.

In this procedure, however, care must be exercised to avoid perforating the root, or breaking off the dowel at a point which will preclude the removal of the remaining end.

## Accuracy in Model Making.

Whilst much emphasis has already been placed upon the necessity for accuracy in impression taking and model making, these features of the procedure are of such paramount importance as to make special emphasis warrantable.

Throughout the entire procedure incident to the construction, or even the repair, of any style of crown, and particularly of those for the anterior teeth, a good impression and an accurate model are prerequisites to success, because by this means the work may be transferred from the mouth to the laboratory with all the exactness which successful achievement demands.

In order that the very best results may be obtained with the greatest degree of accuracy and expediency, the impression should always be taken in plaster because of its being the most reliable material; and the model obtained from it must support and sustain the cap—or caps—in the proper and exact relation which, when in the mouth, they bear to the roots, to the adjacent teeth, and to the gingival outline of the tissues.

The facility with which the cap, or caps, may be detached or removed from the model—and in such manner as to admit of ready and accurate readjustment—depends largely upon the observation of the detail of filling the interior of the cap, and covering the dowel, with a thin film of melted wax just previous to filling the impression, as is illustrated in Fig. 154 for a lateral and in Fig. 155 for a bicuspid crown.

This simple precaution readily admits of the easy detachment of the cap from the model, and of its accurate subsequent replacement, both of

which remove any difficulties or obstacles incident to the construction and assemblage of the parts, and to the subsequent removal and investment of the piece; and the preservation of the model thus made possible, affords opportunity for final trials at any time during or after the completion of the case, all of which are advantageous features.

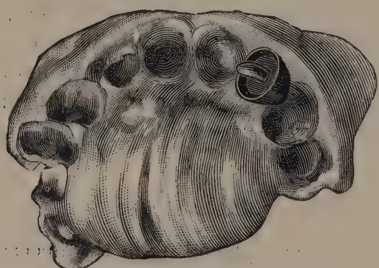


Fig. 154.

Fig. 155.

When the model has been separated from the impression, the cap may then be easily removed by slightly warming the surplus end of the dowel over a flame, and grasping it firmly with flat beak pliers, when a straight pull will quickly detach it, and yet leave an outline of such accuracy as to admit of its easy and correct readjustment to position. Fig. 156.

Fig. 156.

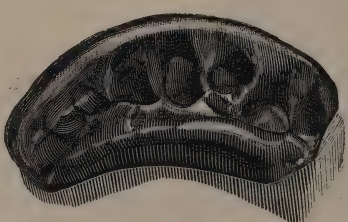


Fig. 157.

After thus removing the cap the wax should be burned out, and it should then be thoroughly cleaned in the acid bath to insure the further removal of all residue from, and perfect cleanliness of, the metal, when it may be placed upon the model, or laid aside for the time being, if prefer-

able, and the wax "bite" adjusted to position, Fig. 157, and the case then mounted upon the articulator.

When more than one crown is being constructed for the same mouth at the same time, one model and "bite" is all that is necessary, but each individual crown should always be *separately* invested and soldered.

**Improved Articulators.**

While the ordinary crown articulator previously illustrated in Fig. 71 may be used, and will, of course, serve the purpose, better results from the viewpoint of a more accurate articulation, which is decidedly advantageous particularly when porcelain is to be employed in any manner, may be obtained from the use of the more improved, and so-called *anatomical,* articulators, which are designed more especially for bridge-work, and which admit of a slight forward, backward and lateral movement.

Two designs possessing these features which seem to be eminently practical are Kerr's Improved crown and bridge articulator, manufactured by Mr. M. M. Kerr, of Detroit, Mich., and the design manufactured by the Blue Island Specialty Co., of Blue Island, Ill., each of which are simple and inexpensive.

# The Plate and Dowel Crown.

CHAPTER X.

Advantages. Indications, Requirements. Method of Construction; Typical Cases; Root Preparation; Six Anterior Teeth, Bicuspids. Adaptation of Plate, Adjustment of Dowel. Extensive Destruction of Root: Swaging Plate; Impression of Root, Dies, Dowels. Construction upon Models.

In view of the great variation of conditions presenting, and because of the possible objections to a band which may be made with reason and consistency in some instances, and in certain classes of cases; together with the advantages to be derived from a close and more or less perfect adaptation of the base of the crown to the end of the root, and the esthetic possibilities afforded—the plate and dowel crown differing from the preceding style by the *absence* of a band, and consisting simply of a plate and dowel base, has a wide range of application and usefulness, and is somewhat extensively employed in the restoration of the ten anterior teeth, and even sometimes on the molars.

**Advantages.**

When the employment of a band is contra-indicated, or seemingly undesirable, such a style of construction affords the advantage of securing a closer line of junction between the crown and the root, by *burnishing* or *swaging* a thin metal base and then adjusting a dowel and completing the crown in the usual manner, than could possibly result from grinding one surface to conform closely with another, such as becomes necessary in the application of the various forms of ready-made porcelain crowns.

While the esthetic possibilities thus afforded are also desirable, the principal features lie in the conservation of tooth structure, the preservation of the normal condition of the gingivae, and the degree of permanency that must result from obtaining a perfect joint between the crown and both the *base* and *periphery* of the root.

**Indications.**

This style of construction is especially indicated in two general classes of cases, and is applicable to a third, as follows:

**First:** In pathological conditions where any extensive preparation of the remaining root, such as would become necessary for a band, is precluded because of its instability, or because of the physical or nervous condition of the patient; or, where a recession of the gum from the normal gingival line would require the application of a crown without a band for esthetic reasons.

**Second:** Where the decay and destruction of the root is so extensive as to preclude the possibility of applying a band,—in which conditions, because of the extreme shortness and consequent close proximity of the end of the root to the border of the alveolus, no opportunity for securing an accurate adaptation of a band is afforded.

In this class of cases a crown may be constructed by swaging or burnishing a base to a close conformation with the surface and irregular edge of the root, with a degree of accuracy of adaptation, and support to the root which will offer a secure and reasonably permanent attachment.

**Third:** It is also quite generally applicable and more or less extensively employed in those typical cases where the root is sufficiently large and strong, and free from the evidences of caries or disintegration, as to probably require no support and protection, such as the application of a band affords.

Also, it is particularly applicable and perhaps most often the desirable procedure, in restoring the crowns of partially developed teeth in the mouths of *young* patients, because of thus avoiding any possible irritation to the more or less susceptible, sensitive and highly organized tissues in such cases.

**Requirements.** The requirements of construction constitute securing a preparation of the root, wherever sufficient tooth structure remains, which will mechanically prevent subsequent displacement of the crown, and of then securing adaptation of the base to both the *surface* and *periphery* of the root, which will afford a firm seating, and, in so far as possible, preclude a dissolution or disintegration of the cementing medium, or the subsequent occurrence of caries.

While a close observation and fulfillment of these requirements will doubtless make such a result possible, the degree of stability in the attachment will, of course, depend much, if not entirely, upon the dowel; which, because of thus assuming a preponderance of the stress imposed, must be properly adjusted to the canal, and of uniform and adequate rigidity.

## Method of Construction.

As the method of construction for this style of crown differs only in the details incident to the preparation of the root, and the adaptation of the base, all reference to the application of the facing and the completion of the crown, whether for gold or porcelain work, will be purposely avoided, because the procedure from this point on is identical with that which is elsewhere considered in connection with each.

**Typical Cases.** In the application of this style of crown to typical cases, such as have been considered in the *first* and *third* classes of indications, and which will be confined mostly to the six anterior teeth, the first essential feature in the detail of construction is the proper preparation of the basal surface of the root.

**Root Preparation.** In this particular the requirements differ from those incident to the band and dowel crown, in that *no peripheral trimming is necessary,* and that the end of the root must be so shaped as to offer mechanical resistance to the stress imposed.

**Six Anterior Teeth.** In the six anterior teeth this may be accomplished by beveling the root both labially and lingually from a central point, so that the plate, which is to form the base of the crown, will straddle the exposed end, thus also overcoming any tendency toward a possible rotation or displacement of the crown.

The *labial* bevel should usually extend from the lingual edge of the pulp canal to a point sufficiently far beneath the gum to allow for the thickness of the plate, and thus admit of placing the neck of the facing in direct contact with the tissue, which adds to the esthetic effect by making the joint invisible.

The *lingual* bevel should not extend quite to the gum line, because of the absence of esthetic requirements upon this surface, and of the probable advantage in having the joint *exposed* to view to insure the accuracy of adaptation, and to the movements of the tongue and action of the secretions, to render it more hygienic or self-cleansing. (Fig. 158 a.)

This preparation may be easily accomplished with flat-edge carborundum stones, though the use of the root facer will facilitate cutting the root below the gum upon the labial surface. Wherever enamel is allowed to remain, however, and no band is employed, this instrument must be revolved slowly, and used with extreme care.

**Bicuspids.** While a similar preparation is usually desirable for first bicuspids, because they are also subjected to some lateral stress, it is not so essential to the

second bicuspids, for the reason that these teeth usually receive vertical stress mainly, hence a flat base, such as is indicated in Fig. 53, is all that is necessary, if the size and adjustment of the dowel is adequate.

**Adaptation of Plate.** When the desired preparation has been secured, a piece of pure gold, or platinum, as the requirements of the intended construction of the crown may indicate, about 34 to 36 gauge, should be cut a trifle larger than necessary, annealed, and burnished to a perfect adaptation with the surface of the root.

This is easily accomplished with flat and round burnishers, and the soft rubber tip of a lead pencil will also be found useful. While the thinness and softness of either pure gold or platinum will admit of securing the required adaptation by *burnishing*, the same may also be accomplished by a primary swaging, if preferable, though the latter method is more requisite in difficult cases, and will be subsequently considered.

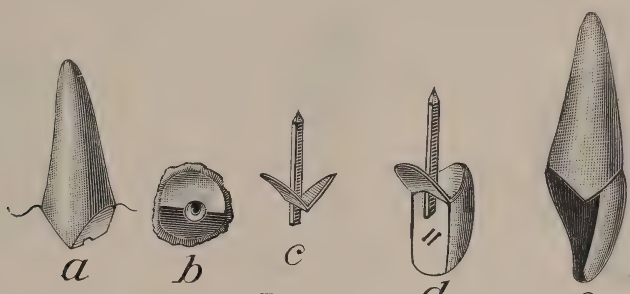



Fig. 158.

**Adjustment of Dowel.** After securing the proper adaptation of the plate, the canal should then be prepared for the reception of the dowel, and the latter fitted to it, when the plate should be replaced in position and the opening of the canal outlined in it with a round or oval burnisher. (Fig. 158 b.)

The plate should now be perforated with a sharp-pointed instrument or plate punch, and the dowel forced through the perforation until well into position. While the close fit thus secured between plate and dowel will usually sustain their relation while removing and soldering, if the same is doubtful, the usual means for sustaining it, as previously described, may be observed.

The two should now be permanently attached with solder and then again placed in position on the root and reburnished, when the surplus may be trimmed away and the plate reinforced to prevent a possible

change of form while taking the impression, and subsequently detaching from the model. (Fig. 158 C.)

When the plate is of gold, this reinforcement should be made by flowing a thin layer of 20 karat solder over the surface and around the dowel, while if a platinum plate has been used, and a porcelain crown is to be made, twenty-five per cent platinum solder, or pure gold, may be employed.

The usual "bite" and impression should now be taken and models secured, when the facing should be selected and ground to a perfect joint with the labial and cervical aspect of the plate, if it is to be backed up and finished with gold (Fig. 158 d), and the crown then completed in the usual manner, and finished and mounted. (Fig. 158 e.)

## Extensive Destruction of Root.

In that class of cases where the root has been more or less extensively destroyed from disintegration, or accident, and presents a concave sur-

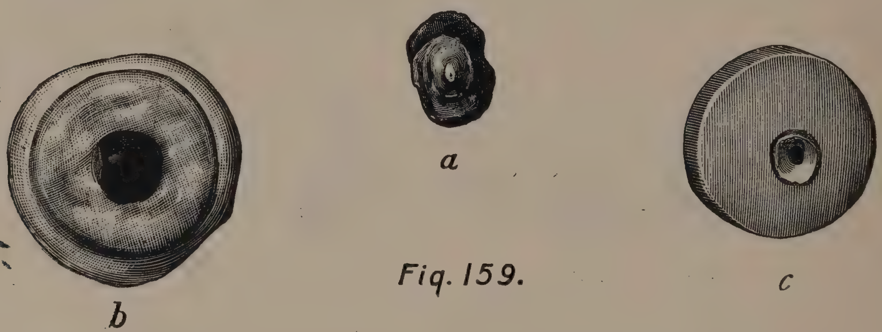



*Fig. 159.*

face and frail and irregular edges so deeply imbedded beneath the gum as to preclude the adaptation of a band, and yet possessing sufficient stability and integrity to afford a reasonably firm attachment for a well-adapted crown, as has been mentioned in the *second* class of indications, the first essential procedure incident to the construction of the crown is to tightly press away the surrounding soft tissue with temporary stopping, or gutta percha, until a *free exposure* of the end of the root is obtained.

While this may require two or three sittings, repeating the procedure at each, such time will be found to have been well expended, when it is desirable to make an effort to successfully crown such teeth, because of thus making possible and facilitating the accurate adaptation of the plate to the root, and the subsequent permanent attachment of the finished crown.

When the root has been thus freely exposed, the irregular edges should be ground down with small stones, or root facer, until as smooth

and even as possible; and all decay then removed, after which the remaining root should be thoroughly disinfected and sterilized, in order to arrest any further progress of caries.

The best means of obtaining the correct adaptation of the plate to the root will depend much upon the condition presenting, and while the required conformation may often be obtained by burnishing, a more certain, and perhaps increased, accuracy will not infrequently be secured by swaging.

**Swaging Plate.** To accomplish the swaging, whenever such procedure may be indicated, or seem desirable, an accurate and well-defined impression of the edge and surface of the root must be taken, and fusible alloy dies made therefrom.

**Impression of Root.** The use of pink base-plate gutta percha affords the most simple and accurate means of obtaining a well-defined impression of the end of the root.

In the procedure this should be cut into moderately small pieces and carefully and slowly warmed, on a mica slab over a flame, or on the electric annealer, until it is *plastic,* when a quantity sufficient to fill the space to be occupied by the crown should be tightly packed with burnishers over and against the end of the root, and in between the adjacent teeth, if any be present.

Care should be observed to avoid over-heating or burning the gutta percha, as such accident entirely destroys its manipulative qualities.

This should now be chilled with a spray of cold water, and removed (Fig. 159 a), and when sufficiently accurate, fusible alloy dies may be obtained from it.

**Dies.** To obtain the dies, the impression should be invested, with the imprint of the root downward, in a base of plaster of proportions sufficient to be subsequently trimmed to admit of the adjustment of the rubber casting ring (Fig. 159 b). When the plaster has become thoroughly crystallized, and has been thus trimmed, it should be placed over a small flame and allowed to heat slowly until the gutta percha may be removed (Fig. 159 c), when the rubber ring should be adjusted, and the die, and subsequently the counter-die, secured with fusible alloy.

Pure gold or pure platinum, as the requirements may indicate, of the thickness of about 36 gauge, should be now annealed, and swaged, after which it may be further adapted to the root by burnishing, as already indicated, and the dowel, or dowels, then adjusted and soldered.

**Dowels** The length and size of the canal, or canals, in such roots will indicate whether one or two dowels should be used, and as they are generally much

*shorter* than usual, and the major portion of the strength of the attachment will depend upon the dowel, it is essential that it should be of adequate size and length to *thoroughly fill the canal;* hence the use of two, whether they may be separate from each other, or in contact and subsequently united with solder, is frequently required.

The relation between the plate and dowel, or dowels, should be temporarily secured in the manner indicated, and then permanently sustained by soldering, and wherever two dowels are used, and particularly when they are separated, an investment should invariably be employed.

When they have been soldered, the cap should be placed upon the root and the edge of the plate readapted by burnishing, in which the use of a smooth foot plugger in the automatic mallet will often be found advantageous.

The usual "bite" and impression should be then taken and the crown completed as the requirements may indicate, as illustrated in Fig. 160.

While the interior of such roots is sometimes previously filled with cement or amalgam, and the plate then adapted to this surface by burnish-

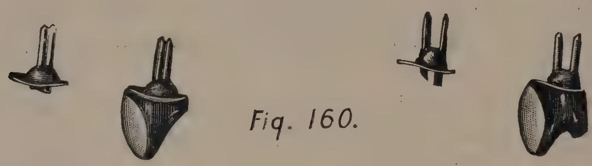


Fig. 160.

ing, the increased accuracy obtained by swaging it to closely follow the concaved surface of the root, and the additional support thus rendered to the latter with a minimum quantity of cement, adds materially to the integrity of the attachment between the two, when subsequently mounted.

**Construction Upon Models.**

In instances where it may become necessary to construct the crown upon models, the most useful and accurate reproduction of the conditions may be secured by first fitting a wooden dowel into the canal and then packing gutta percha over and around it, until the impression of the end of the root has been obtained, as indicated.

When the desired degree of accuracy has been thus secured, it should be placed in position, and a plaster impression then taken over it. The removal of the latter will usually bring the gutta percha with it, but if not, it should be detached from the root and placed in its proper position in the impression.

When this has become thoroughly dry, the open ends may then be closed up with mouldine, and the impression filled with fusible alloy.

After separating from the plaster, and detaching the gutta percha and wooden dowel, this procedure will result in a metal model with a more or less perfect reproduction of the root and its canal, upon which opportunity is afforded for the construction of the crown in the manner indicated, and with reasonable accuracy.

[The application of this style of crown to the molar teeth is perhaps confined more especially to porcelain work, but the same general principles should be observed irrespective of the style of construction.]

# Application of Dowel Crowns Without Plate or Band.

CHAPTER XI.

Advantages; Disadvantages; Indications; Requirements; Various Designs; Separable Dowels, Inseparable Dowels, Comparative Advantages. The Davis Crown: Application, Mounting, Repairing, With Band and Cap; Accuracy of Adaptation Without Band. The Logan Crown: Comparative Advantages and Disadvantages; Application; Mounting. With Band and Cap. Advantages; Procedure. Variation of Methods: Substituting Separate Dowel; Procedure. Increased Accuracy of Adaptation, Procedure. Porcelain Work. The Brewster Crown: Application. The "Fellowship" Crown: Application. Repairing. Tube Crowns: Application; Procedure. Temporary Crowns: Indications; Procedure; Use of Amalgam; Use of Vulcanite.

The various styles of ready-made porcelain crowns which are designed to be adapted directly to the root, without the employment of a band or plate, and attached by means of a dowel, which may be either a separable or inseparable part of the crown, will, in regular sequence, be *designated* and *considered* under this classification.

While almost any of the several designs of this particular style of crown may be adapted with a band and cap, or even with a simple plate, they are thus classified because of being usually employed without such addition, and of being originally designed to be so adapted.

Although this particular style of crown preceded all others designed especially for the anterior teeth, they are still used somewhat extensively, and, irrespective of the improved means for obtaining greater *integrity* and *permanency,* they doubtless possess some intrinsic advantages, and still occupy a more or less limited sphere of *usefulness* and *serviceability.*

**Advantages.**

Previous to the individual construction of porcelain-faced crowns, the application of porcelain work, and the present facilities for securing a more perfect adaptation to the root with equal opportunities for observing the esthetic requirements, as indicated in the preceding chapter, the advantages possessed by this style of crown were particularly desirable.

These constituted the ease with which the finished crown might be procured; the absence of the necessity for removing the enamel from

the periphery of the root; the *facility* and *dispatch* with which they might be adapted, and the *natural* and *translucent* appearance which the splendid forms and colors of some makes afforded.

While the latter is always an eminently desirable feature, particularly in the restoration of the six anterior teeth, and gives to all porcelain crowns of any similar design a distinctive advantage over those in which the translucency is destroyed by the presence of a backing, the former should be so considered in the application of crowns designed to serve as permanent reproductions, only when such are especially indicated, and as a means of expediency.

**Disadvantages.** The principal features which may be reasonably regarded as disadvantages, when such crowns are adapted without band or plate, lie in the difficulty of obtaining a crown of the same diameter as the root, and of securing a continuous and practically impervious joint between it and both the *base* and *periphery* of the root, together with the resultant absence of *preventive means* and *prophylactic* measures against the subsequent *dissolution* or *disintegration* of the cementing medium from the penetration of saliva, and the destruction of the root by caries or fracture.

As the result of a failure to observe the higher requirements in this connection, many roots have been lost from caries, or fracture, which might otherwise have possessed greater *integrity* and *usefulness;* and it is by no means uncommon to see such crowns so displaced from the stress of mastication, and the inherent weakness of the dowel, as to effect a disarrangement of the alignment, and afford a pocket between crown and root which serves as a receptacle for the accumulation of the products of decomposition.

**Indications.** In consequence of these possible disadvantages the application of such crowns without a band or plate, or without observing some means of securing a more *perfect* and *impervious* joint than can usually be obtained by grinding one surface to fit, and approximate with, another, is usually indicated only in those cases where *expediency* renders such choice absolutely necessary; or where, from the instability of the root, a recession of the gum tissue, or other pathological conditions, or for pecuniary reasons the application of a crown affording greater *stability in the attachment,* or *greater protection to the root,* may not seem warrantable.

And even in such instances their application should usually be confined to the six anterior teeth, because of the increased difficulty ordinarily encountered in adjusting them to the more or less *irregular shapes* and *uncertain canals* of the bicuspids and molars.

Conscientiously considered, such crowns must usually be regarded as *temporary work,* in view of the reasonable opportunities for securing greater permanency.

## Requirements.

In the application of any of the various designs now used, the same esthetic requirements as indicated in the preceding chapter prevail, and the possible permanency of the crowns will naturally increase in proportion to the degree of accuracy obtained in adapting them to a close approximation with both the base and peripheral outline of the root; and much of the success attending such an adaptation will depend upon the proper root preparation.

**Root Preparation.** In the preparation of the root for the reception of such crowns, the removal of enamel, or peripheral preparation of any kind, becomes entirely *unnecessary,* of course, but the shape given to the basal surface should differ

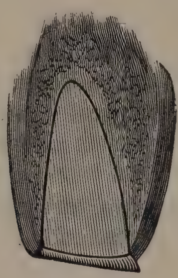


Fig. 161.

from that indicated for the plate and dowel crown, because of the increased difficulty of securing an adaptation to such a shape, *by grinding.*

With the exception of the peripheral trimming, the preparation previously indicated in Fig. 50 will be found the most favorable to the requirements of the crown, and to the facility and accuracy with which the adaptation may be secured.

This consists in grinding the *labial* edge just beneath the gingival line, and in allowing the *lingual* to project slightly beyond it, with the basal surface assuming a smooth *inclined plane.* (Fig. 161.)

The former admits of the advantages considered in this connection in the preceding chapter, while the latter greatly facilitates the opportunities for securing the desired and required adaptation of the crown to the root.

## Various Designs.

Although numerous designs of this style of crown have been presented from time to time, as previously recorded, only those which are now manufactured in good variety, and which are more or less extensively employed, will be considered. In their consideration it becomes necessary to divide them into two classes, because of the variation in their construction, and in the details incident to their respective application. Such variation mainly depends upon the possession of *separable* or *inseparable* dowels, and causes them to be classified accordingly.

**Separable Dowels.** The feature of this class of crowns embraces a separable or removable dowel, which may be previously mounted in the root, and to the projecting end of which the crown may be subsequently attached. They are designed for the purpose of facilitating the adaptation of the crown to the root, and include the principles of the Davis crown.

**Inseparable Dowels.** This class of crowns embraces the feature of an inseparable dowel, which is baked in or otherwise securely attached to, the porcelain, and forms an integral part of the crown, such as the Logan, Brewster and "Fellowship" designs.

**Comparative Advantages.** While both of these styles, and all of these respective makes of crowns, are much used at the present time, and either is capable of being more or less readily adjusted to the root, a close study and analysis of the comparative advantages of the two classes must result in favor of those possessing a separable or removable dowel, providing, of course, that adequate means are afforded for the subsequent attachment of the crown.

This is apparent, for the reason that the opportunities for securing the closest possible adaptation, by grinding, are greatly facilitated by the temporary absence of the dowel, as its presence must necessarily afford some obstruction to this procedure, and at least increase the difficulties attending it, together with the liability of weakening the dowel, by grinding it, during the process.

## The Davis Crown.

Of the several designs of crowns possessing separable dowels, the Davis crown, suggested by Dr. Chas. H. Davis, and manufactured by the Consolidated Dental Manufacturing Co., is the only one which is now employed to any extent, or which is made in a sufficient variety of moulds and colors to meet the requirements, and it has quite an extensive application.

It is an all porcelain crown, having a slightly concaved base,

in the center of which is a depressed rim, which affords a rest for the shoulder on the dowel, and a countersunk cavity extending into the crown sufficiently deep to accommodate the projecting end of the dowel.

The dowel is proportionate with the size of the crown; slightly tapered; corrugated throughout its entire length to afford increased attachment to the cementing medium; has one flattened side to prevent the possibility of rotation, and a shoulder which adapts itself to the depressed rim for its accommodation in the crown, and is made of German silver alloy for the purpose of obtaining greater inherent strength and rigidity than is possessed by platinum. (Fig. 162.)

**Application.** When the proper selection has been made, the primary rough grinding may be done upon the model if the outline of the root is sufficiently accurate, but the final adjustment to the desired adaptation should be

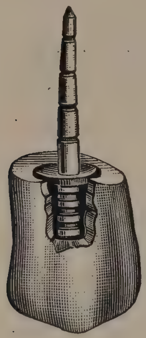
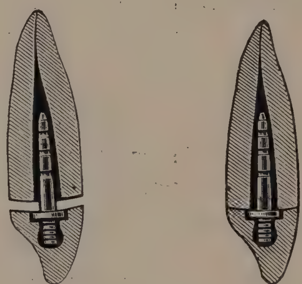


Fig. 162.



a Fig. 163. b

made directly upon the root itself. This should be accomplished with carborundum stones in the engine, and when sufficiently accurate the ground surfaces, excepting the base, should be then nicely polished with disks.

The canal should now be prepared for the reception of the dowel, and the latter fitted closely to it; in some roots it may become necessary to shorten it somewhat from the apical end. When thus primarily fitted, it should be placed in position in the crown and temporarily sustained with wax until the two may be adjusted to position on the root. (Fig. 163, A.) This may necessitate a slight enlargement of the basal portion of the canal, or possibly the bending of the dowel, until the adjustment of the crown to its proper relation with the root is obtained, after which the crown and dowel may be permanently mounted. (Fig. 163, B.)

**Mounting.** In mounting, all particles of wax should be thoroughly removed from the crown and dowel, and the root rendered aseptic and dry, when the attachment of the latter to both crown and root may be made simultaneously with cement, or if it is preferable to use gutta percha, the dowel should be first fixed in the crown with cement, and attachment to the root made with gutta percha.

**Repairing.** One of the most important advantages possessed by this style of crown is the *ease and facility* with which repair may be effected in the event of subsequent fracture.

In such instances the dowel need not usually be disturbed, as its projecting end will afford ample opportunity for the retention of a new crown, after the removal of the remaining cement, and the necessary adaptation has been secured by grinding. These crowns may also often be found applicable and useful in the repair of the Logan, and other styles of crowns, where no backing is used, and the projecting end of the dowel remains sufficiently long to afford adequate *retention* and *resistance.*

**With Band and Cap.** When it may seem *desirable* to employ the band and cap, in the adaptation of this crown, and thus add to its possible *permanency* by supplying means for the *protection* of the root, it may be accomplished with ease.

In their application in conjunction with band and cap, the root should be prepared and the band fitted in *exact accordance* with the principles previously outlined in connection with the *band* and *dowel crown.*

When the band has been thus fitted and trimmed to the proper width, and the root ground down to evenly approximate its edge, as indicated in Fig. 125, B, the crown should be selected and ground to a close conformation with the basal surface of the root, as well as its peripheral outline.

The dowel should then be temporarily adjusted to the crown and fitted to the canal, until the crown may assume its proper relation. A plate of pure gold, 32 gauge, should now be perforated for the dowel, placed in position on the crown, and trimmed to follow its outline, with an allowance of about 1/32 of an inch surplus around the entire circumference.

After annealing this plate, it should be again placed in position on the crown, and both adjusted to the root, with the band in place. A degree of accuracy in the adaptation of the plate to the root, crown, and edge of the band may be obtained by placing a piece of soft wood against the end of the crown, and gently tapping it with a mallet, and then holding firmly and *burnishing the surplus edge* of the pure gold plate up tight against the band.

When this has been accomplished, the crown should be removed, and the pure gold plate placed in its proper relation to the band, which has been made possible by the burnishing of this surplus edge, and the two then united with 20 karat solder.

When the cap has been formed by the union of the band and plate, and the surplus and excess edge finished down smooth with stones and disks, it should be adjusted to position on the crown (to which the dowel still remains temporarily attached) and securely united with wax.

The interior of the cap should now be filled with investment material, or plaster, as indicated in Fig. 127, in order to securely sustain their relation while soldering. After this has become sufficiently hardened, the crown may be easily detached by slightly heating it over a flame until the wax melts, when the dowel should be united to the cap by filling in the space around the shoulder with 20 karat solder.

The cap may now be finished and polished, and then permanently attached to the root, when the crown may be placed in posi-

Fig. 164.

tion, and if too long, because of the thickness of the pure gold between it and the root, the incisal end should be ground until the length is correct and the crown then subsequently mounted with cement. (Fig. 164.)

While the floor may be attached to the band in the ordinary manner, without observing this detail, and the proper relation between the parts subsequently secured, this procedure is warrantable and preferable because of the accuracy and the conservation of tooth structure thus obtained, as otherwise the canal may need to be much enlarged to admit of placing the crown in its proper position and relation.

**Accuracy of Adaptation Without Band.**

A method of securing a preservation of the root, and a degree of accuracy in the adaptation of these crowns, without a band or cap, which seems quite practical and applicable to many cases, has been suggested by Dr. J. R. Owens, of Cleveland, Ohio.

In this method the basal end of the canal is enlarged as much as is consistent with the strength of the remaining edge of the root, and then somewhat countersunk. (Fig. 165, A.)

The crown is then adjusted to its proper adaptation by grinding, and the dowel subsequently fitted until admitting of the correct adjustment of the crown, when the dowel should be mounted in the constricted portion of the canal with cement.

The surplus cement flowing into the countersunk cavity should be removed and the latter then filled with amalgam. (Fig. 165, B.) While this remains plastic, the crown should be placed in position and gently forced to its proper adaptation with a piece of soft wood and small mallet. The excess amalgam is then trimmed away, until a smooth joint between crown and root remains, when the crown should be gently removed and afterward permanently attached with cement. (Fig. 165, C.)

The advantages claimed for this method are the protection afforded

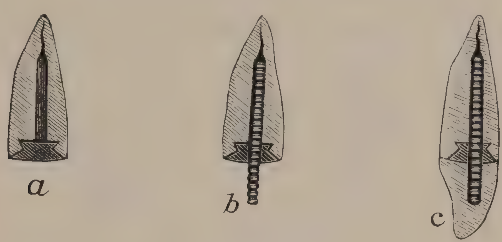



*Fig. 165.*

to the end of the root by the amalgam, and the accuracy of the adaptation between crown and root which is facilitated by its manipulation while in the plastic state. Its application, however, is necessarily confined to good, strong roots, and while the How "screw-post" is used by the advocate, as illustrated, the dowel of the Davis crown will doubtless answer as well.

## The Logan Crown.

Of the various crowns with fixed, or inseparable dowels, the Logan crown, originally designed by Dr. M. L. Logan, and manufactured by the S. S. White Dental Mfg. Co., is, because of the almost unlimited variety of splendid forms and colors in which it is made, probably the most generally employed and universally adaptable.

The crown is made with a slight groove or depression in its base, immediately surrounding the dowel, thus forming an elevated rim around the edge which facilitates the adaptation, and, when not entirely

obliterated by grinding, affords increased strength to the attachment by admitting of the presence of a greater quantity of the mounting material.

The dowel is of platinum and is baked into the body of the crown. It is flattened and tapering in shape, and adjusted in the crown with the greatest diameter placed *labio* and *bucco-lingually*, or in line with the direction in which the greatest stress is usually imposed; and a slight corrugated depression in each side aids the attachment of the mounting material. (Fig. 166.)

**Comparative Advantages and Disadvantages.**

While this form of dowel is based upon theoretically scientific principles, objectionable features of some importance contra-indicate its too general application, and detract from its practicability. These constitute the possible weakening of small roots by the enlargement of their canals to the extent necessary to accommodate the greatest diameter of the dowel; the possibility of its bending under the application of stress in the line of its smallest diameter, and the inherent weakness of a *platinum* dowel which is further an-

Fig. 166.

nealed to its softest form by being subjected to the high degree of heat necessary to fuse the porcelain.

In many cases this required destruction of the root may leave it so weakened as to be more or less easily fractured, if no band is employed, which is not an uncommon occurrence; and the lack of *rigidity* in the dowel, particularly in its lateral dimensions, affords opportunity for it to bend under stress in this direction, and thus admit of the displacement of the crown, which tendency or possibility may not always be overcome by the close approximation of the crown to the adjacent teeth.

In such cases, and especially where the latter is not possible, unless extreme care be taken, the employment of a crown possessing such a dowel may be contraindicated, and the application of one with a more round and rigid dowel may be found more serviceable.

**Application.**

In the application of the Logan crown the root should be prepared, a model secured, and the selection made in accordance with the previously mentioned requirements for this general style of crown.

A more accurate selection of the crown for the individual case may be greatly facilitated by preparing the canal after shaping the root, and then adjusting a temporary dowel of wood or metal, allowing it to pass well into the canal and to extend down to, or near, the incisal end of the adjacent teeth. (Fig. 167.) The end of an ordinary wooden tooth-pick will answer this purpose nicely, and when so adjusted, a modeling

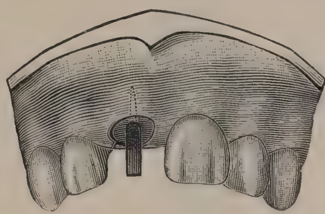


*Fig. 167.*

compound impression should be taken with it in position.

In removing the impression, the temporary dowel should remain firmly embedded in it, or be subsequently so placed, and the model made.

The removal of the dowel from the model will leave an outline of the canal, and indicate its size, and position, in relation to the root, all of which will be found decidedly convenient in, and advantageous to, the selection of the crown, because of the facility with which it may be readily adjusted to place. (Fig. 168.)

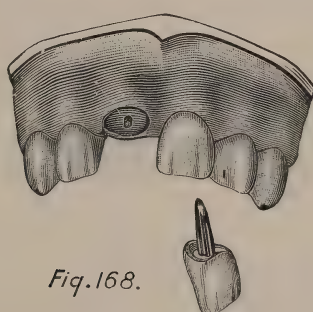


*Fig. 168.*

While the final adaptation of the crown should always be made directly upon the root, the above procedure will be found additionally advantageous if the impression is taken in plaster, and, after drying thoroughly, then filled with fusible alloy. This affords an accurate and comparatively indestructible model containing the outline of the base of the root, and a reproduction of the canal; and the crown may be selected,

and primarily ground to a fairly accurate adjustment upon it, during the absence of the patient.

The grinding to the proper adaptation should be accomplished with small flat-edge carborundum stones, in the engine, and care must be observed to avoid cutting into the dowel, or weakening its attachment to the porcelain. (Fig. 169.) The use of curved stones, suggested by

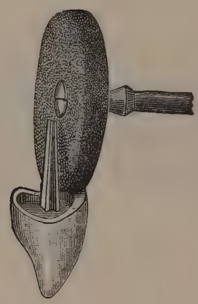


*Fig. 169.*

Mr. Robert Brewster, will be subsequently mentioned (Page 214) and may be found useful.

In the final adaptation of the crown, the use of small disks of carbon paper, perforated so as to slip over the dowel and rest against the base, with the carbon side placed next to the porcelain, will be found serviceable in securing a close approximation. (Fig. 170.)

In the use of such disks, as the crown is pressed to place, the points of contact between it and the root will be designated by a black mark

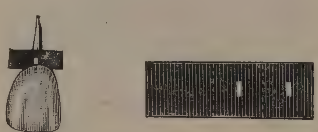


*Fig. 170.*

on the porcelain, and the grinding at such points should be continued until the entire base thus indicates a uniform contact.

The requirements of peripheral approximation and occlusion should now be observed with care not to destroy the integrity between crown and dowel, and when the adaptation has been completed, any surfaces of the porcelain which have been ground, excepting the base, should be nicely smoothed and polished with disks, and the crown then mounted.

**Mounting.** While many methods of mounting this style of crown are advocated, and the subject in general will receive subsequent consideration, the permanency of the attachment by any method will, of course, depend much upon the accuracy of the adaptation. Where the joint is close enough to be rendered practically impervious, either cement or gutta percha may be used, as is the practice, and at the discretion of the operator.

The indications for the use of gutta percha increase, however, in proportion to the inaccuracy of the adaptation, and the two materials may be combined to advantage if desirable. In this procedure a disk of the ordinary pink base-plate gutta percha should be cut a trifle larger than the base of the crown, and then perforated to slip over the dowel. The latter should now be slightly roughened with a sharp instrument, and both it and the base of the crown then moistened with oil of cajaput or any solvent, and the gutta percha disk adjusted to position.

It should then be placed on the electric gold annealer, or on a mica slab, over a flame, and slowly heated until the gutta percha becomes plastic, when, after moistening the root with water to prevent adhesion, the crown may be forced to place with enough pressure to mould the gutta percha to it, and to the root, and to fill the intervening space.

While the crown is now held firmly in place, the surplus should be trimmed away around the joint with a sharp, warm instrument, after which it should be removed and again placed upon the heating apparatus, until the root has been dried, and the base then moistened with the solvent, when it may be mounted with cement in the ordinary manner.

A similar procedure is indicated in the use of gutta percha alone.

## With Band and Cap.

Several methods of employing the Logan crown in combination with a band and cap have been suggested as a means of obtaining greater permanency in their application; and when so adapted this or almost any of the various forms of such crowns possesses advantages which place them next in rank to porcelain work.

**Advantages.** Such advantages constitute not only the increased integrity of the attachment, and preservation of the root, but include the esthetic possibilities which may be obtained in the translucent and natural appearance afforded by an all porcelain crown devoid of the presence of any backing.

**Procedure.** Of the several methods advocated for so adapting this style of crown, a modification of the one devised by Dr. J. G. Hollingsworth will be found to be the most generally applicable and universally practicable.

This consists in preparing the root as previously indicated in connection with the *"band and dowel" crown* and the *Davis crown with a band,* and in fitting the band and constructing the finished cap *in the same manner as prescribed for the former.*

The crown should be selected in accordance with the details indicated, and this may be observed either before or after the adjustment of the cap. In grinding it to the proper adaptation, however, the cap should be laid aside, and the adjustment made directly to the root, in which procedure *the original form of the base of the crown is entirely changed,* and it is only necessary to observe accuracy along the labial edge. (Fig. 171, A.)

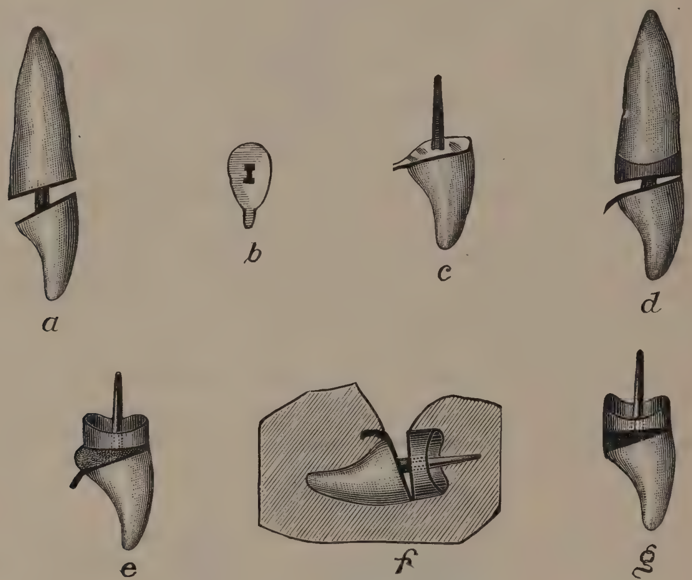



*Fig. 171.*

When a moderately accurate adaptation of this surface has been secured, together with an observation of the remaining requirements, the cap should be placed in position on the root, perforated to receive the dowel, and the *final adjustment then made with it in place.*

When the required adaptation has been thus obtained, the base of the crown should be further ground away on the *lingual* and *approximal* edges until an adequate V-shaped space exists between this portion of it and the cap. The space should be large enough to admit of being subsequently filled with solder, by which means the crown and cap are permanently attached, but should be no larger than necessary to facilitate

this procedure, because of the possible weakening of the attachment of the dowel in the porcelain.

The perforation of the cap should be made with care to have the dowel *fit* closely into it, as a preservation of the accurate relation between crown and cap, and the facility with which a strong union between them may be effected, will depend much upon such a relation. In the event of making too large a perforation, an additional disk of thin gold or platinum may be more accurately adjusted to the dowel, burnished to place on the cap, and separately soldered in its proper position, thus overcoming any possible difficulties in this connection.

The crown should now be backed up with a disk of *platinum,* about 36 gauge, which should be properly perforated, annealed, and closely burnished to place. In trimming it to follow the outlines of the base of the crown, a slight *lingual* extension (Fig. 171, B) should be allowed to remain, for the purpose of engaging in the investment material, and thus retaining the backing in close proximity with the porcelain during the process of soldering If this precaution is not observed, the backing will invariably be drawn away from the base of the crown, as a result of the shrinkage of the solder, thus diminishing the strength of the union, and affording an unhygienic joint.

A backing of pure gold might also be used instead of platinum, but the extreme thinness necessary to admit of carrying the porcelain well up to the gingival line would only introduce the possibility of fusing it during the process of filling this small space with solder.

When the backing has been adjusted, it should be attached in position on the crown with melted adhesive wax (Fig. 171, C), and the relation between crown and cap then secured on the root (Fig. 171, D), with the same material. To accomplish this with accuracy and facility, the cap should be placed in position on the root, kept perfectly dry, a little adhesive wax melted on the backing around the dowel, and the crown then quickly carried to place in its relation to the cap.

If the adhesive properties of the wax are not destroyed by the presence of moisture, and it is sufficiently heated to admit of the proper adjustment of the crown, the relation will be securely sustained, and crown and cap may be safely detached from the root with a small pointed excavator passed around the edge of the band.

The remaining space in the joint should then be completely filled with wax (Fig. 171, E), and the crown invested. Previous to investing, the lingual extension of the backing should be bent over *toward* the porcelain *without overlapping* upon it, until it may be so engaged in the investment material as to be held in place, yet offering no impediment to the soldering.

When the investment has crystallized, it should be trimmed down until as small as possible, to possess sufficient strength to hold the parts together. The wax should now be removed, and the joint between cap and backing then *freely exposed,* so as to admit of, and facilitate being filled flush with solder (Fig. 171, F.) The case should now be fluxed, heated thoroughly, and the space then filled with 18 karat solder.

In soldering such crowns, it must be remembered that the porcelain contains a large mass of platinum, hence it becomes necessary to first heat the porcelain well, in order to prevent the occurrence of a fracture.

In filling the joint, the solder should be cut in small pieces, and each one of these *consecutively applied and fused,* to assure its penetration to the full depth; and a *secure attachment to the dowel,* which, being covered with investment material, and being most remote from the exposed surfaces, is in consequence the most difficult to heat thoroughly.

This occasionally accounts for a failure to unite the crown to the cap, and in the event of such an accident their union may be subsequently effected by again investing, leaving only the *interior of the cap and the dowel exposed,* and attaching with a minimum of solder at the point of junction between the two.

The contouring of the solder to a flush smooth surface may be somewhat facilitated by cutting small triangular pieces of platinum or gold foil, or *thin* plate, and adapting them to the approximal sides of the wax in the joint, *before investing,* thus forming a matrix for the solder.

When the soldering has been completed and the cap becomes an integral part of the crown, it should be finished and polished as usual (Fig. 171, G), and then mounted.

## Variation of Methods.

Several other methods of securing additional stability in the application of such crowns are employed, and at least two of them may often be used to advantage. These consist in *excising the original dowel* and replacing it with a *separate* one; and in *burnishing or swaging a thin plate to the basal end of the root* and attaching it to the crown and dowel, as a means of securing a more perfect adaptation without the use of a band.

**Substituting Separate Dowels.**

Cases not infrequently present where it may be difficult to secure a proper adjustment of a *fixed-dowel* crown, because of the constricted size, or unfavorable location of the canal; or the position or shape of the root. In such instances the accomplishment of good results with the use of this style of crown may occasionally indicate, or even

necessitate, the excision of the original dowel, and the employment of a separate one.

**Procedure.**

When this procedure seems required, the cap should be constructed as usual, and an ordinary platino-iridium dowel fitted to the canal and soldered to it, allowing but a *short* projecting end to extend beyond the floor and toward the porcelain, so as to offer no, *or a minimum,* obstruction to the subsequent adjustment of the crown.

A suitable crown should be then selected and its dowel cut off at a point about 1/16 of an inch from the base, when it may be ground to the proper adaptation, as further indicated in the preceding method. It should then be backed up in a similar manner, excepting that the backing may be trimmed to follow the entire outline of the base of the crown, and separately invested, so as to afford a *full exposure* of the surface of the backing (Fig. 172, A). When properly heated, this may be securely attached to the short projecting end of the dowel with solder.

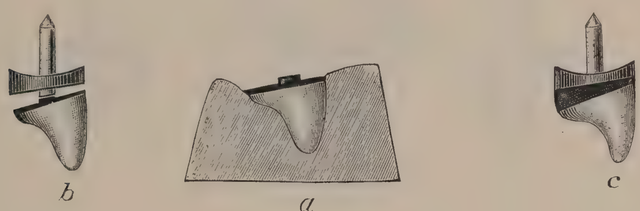



Fig. 172.

The proper relation of the crown to the cap (Fig. 172, B) may now be secured and sustained with adhesive wax, and the parts removed, invested and soldered, as indicated. The finished crown is illustrated in Fig. 172, C.

As the degree of strength obtained in the union of the crown with the cap and dowel will depend much upon the length of the projecting end of each dowel, and naturally increase in proportion thereto, this procedure should be confined to extreme cases, or to those wherein the length of the crown may admit of a sufficient exposure of the ends of the dowels to insure a degree of integrity in the finished crown.

**Increased Accuracy of Adaptation.**

A method of securing increased accuracy in the adaptation of the crown to the root, which is applicable in many instances where it is not desirable to employ a band, was perhaps originally suggested by Dr. Gordon White, of Nashville, Tenn.

This consists in shaping the root, adapting the crown, and changing its original form, as previously described.

**Procedure.** In the procedure incident to the employment of this method, a disk of platinum foil, about No. 40 or 50, is annealed, perforated for the dowel, and burnished to a close adaptation to the base of the crown, after the latter has been properly ground, as indicated (Fig. 173, A). A second disk is then cut somewhat larger than necessary, to cover the end of the root, and closely adapted to it, thus forming a V-shaped space between the two surfaces of metal which is subsequently filled with solder, in the manner previously outlined. (Fig. 173, B.)

The first disk, which forms a backing for the crown, should have a slight lingual extension for the purpose of sustaining its close proximity with the porcelain while soldering; and the second disk, which is adapted to the base of the root, should possess a slight surplus on the

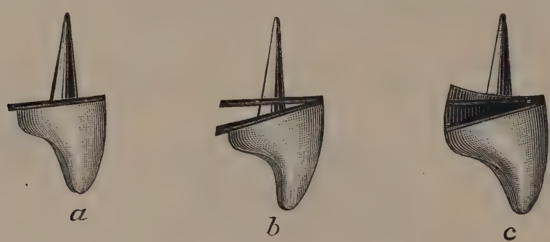


Fig. 173.

*lingual* surface, which may be slit and burnished up over this portion of the root, thus resulting in the additional support of a partial band.

In securing a proper and close adaptation of each to their respective positions, the first disk should be placed in position on the crown, burnished, and trimmed, and then attached to the dowel with adhesive wax. A sufficient quantity of the latter to a little more than fill the space between crown and root should then be placed over this, and the second disk adjusted to position on the wax and attached by touching it with a hot instrument. The wax should then be chilled with cold water, the crown and disks placed in position on the root, and force enough applied with a piece of wood and small mallet to carry it well to place, which will *swage* the second disk to a close conformation with the base of the root, if enough wax is present.

The whole should then be removed and the surplus wax trimmed down flush with the crown. The second disk may now be trimmed to closely follow the outline of the root, excepting upon the lingual, which

portion may be slit, as suggested, and burnished up over this surface of the root upon the replacement of the crown. (Fig. 174.)

When this has been accomplished, it should be removed, and invested, and soldered, with an observation of the previously mentioned requirements and precautions in this connection, and the finished crown is illustrated in Fig. 173, C.

In roots possessing an irregular outline or concave base, this, or a similar, procedure may be found advantageous; and the disk which is to be adapted to the root may be made of a heavier gauge of platinum when indicated, or desirable, in the manner previously recommended in connection with the "*plate and dowel crown.*"

**Porcelain Work.**

This procedure is also equally applicable to porcelain work, and when porcelain is preferable to the use of gold solder, for uniting the plate to the crown, the details differ only in dispensing with the *first* disk, as this

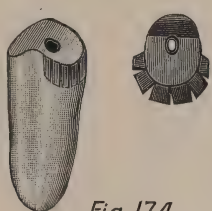


Fig. 174.

is used simply as a backing for the crown, and no backing becomes necessary in porcelain work.

The adaptation of the disk to the base of the root, and the manner of obtaining and sustaining its relation to both the crown and root, may be accomplished as indicated, but the case should then be invested and the disk permanently attached to the dowel with pure gold, or twenty-five per cent platinum solder, before filling the intervening space with porcelain, as a means of precluding any possible change of relation which may accrue as a result of the shrinkage of the porcelain body in fusing.

## The Brewster Crown.

Among the several other varieties of porcelain crown possessing fixed dowels, the Brewster crown, designed and manufactured by Mr. Robert Brewster, of Chicago, Ill., is more or less extensively employed.

It is made of porcelain body, quite similar to Ash's English teeth, in a good selection of moulds and colors, with a slightly concave base,

and a *round* dowel. The latter is made of a composition metal similar to the alloy of German silver, and is attached to the crown with a low-fusing body. This enables it to possess the advantage of strength and rigidity, as well as economy, and yet the attachment between crown and dowel seems quite secure (Fig. 175, A).

**Application.** The application of this crown may be made whenever the employment of a fixed dowel crown is indicated, or desirable; either with or without a band or plate; and the detail of procedure, in each instance, is identical with that indicated for the Logan crown, excepting that the composition of the dowel and its manner of attachment in the porcelain preclude its use in connection with porcelain work, where it is necessarily subjected to a high degree of heat in the furnace; though the same readily admits of the use of 20 karat solder.

The favorable shape of both crown and dowel, and the comparative ease with which it may be procured and adjusted, combined with its


Fig. 175.

inexpensiveness, make it very useful for *temporary* purposes; but when employed as a permanent crown the dowel should be slightly flattened on at least one side (or serrated), in order to facilitate the attachment of the cementing medium, and thus prevent possible rotation or loosening.

The adaptation of the base of the crown to the root may be accomplished with greater facility, and less danger of grinding the dowel, by the use of *curved* carborundum wheels, which are designed and recommended by Mr. Brewster for this purpose. (Fig. 175, B.)

## The "Fellowship" Crown.

The "Fellowship" crown, devised and manufactured by the Dental Protective Supply Co., is constructed along lines similar to the preceding crown, and is also more or less extensively employed.

Any possible rotation of the crown on the dowel, or in its attachment to the root, is prevented by the shape of the dowel, and the manner in which it is attached to the porcelain. The shape, however, is similar to that of the dowel of the Logan crown, and in consequence possesses

the same objectionable features. It is made of a German-silver alloy, and is attached in the crown by means of an additional piece of wire passing laterally through perforations in the base of the crown and end of the dowel, which are then subsequently filled flush with low-fusing body. (Fig. 176.)

**Application.** The details of procedure in the application of this style of crown, and the indications for its employment are practically the same as those previously described.

## Repairing.

In the event of the subsequent occurrence of a fracture of the porcelain in any of the various forms of fixed-dowel crowns, the method of repair is often difficult and sometimes even impossible; and the best

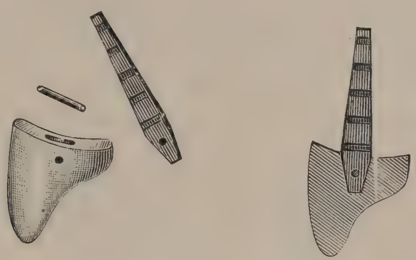


Fig. 176.

results are usually accomplished by removing the remaining dowel and adapting a new crown.

When it has been mounted with cement, however, and particularly in small constricted roots, this is often a difficult and sometimes dangerous procedure; but may be accomplished by drilling out the cement immediately surrounding the dowel with a very small round bur until it may be gradually loosened and removed, in which extreme care must be exercised to prevent perforating the root or breaking off the dowel at a point which will likely preclude the removal of its apical end.

In very small roots or where either of the latter results seem at all probable, the method suggested by Dr. Joseph Head, of Philadelphia, may be employed to advantage. This consists in cutting the dowel into two lateral halves by drilling vertically through its smallest diameter with a small round bur, and when so divided, the space thus produced will admit of loosening each half until their separate removal may be effected without danger of weakening the root. A pair of forceps designed especially for this purpose by H. N. Lancaster may also be found very useful.

In those cases where the dowel remains firm in its attachment to the root, and the length and strength of its projecting end will afford adequate means of sustaining a new porcelain crown, it may often be left in place and a Davis crown adapted to the root and then cemented to it; or, a crown may be *constructed* possessing a *socket* in its base which will fit and engage the projecting end of the dowel and securely sustain it in its proper relation, when mounted with cement. As this latter procedure involves the construction of a crown which may often be found useful and practical it will be separately considered under the classification of *tube crowns*.

## Tube Crowns.

This style of crown is adaptable to that class of cases previously referred to wherein the original has been broken away leaving the dowel still firm in its attachment to the root; and may be employed as a means of substituting a well adapted crown when, for any reason, it may not be deemed advisable, or desirable, to remove the remaining dowel.

The application of such a procedure and of the principles involved was probably first suggested by Dr. Wm. Mitchell, of London, England, but is also advocated and employed, as applied particularly to porcelain work, by Dr. Jas. E. Keefe, of Chicago, Ill., and Dr. F. J. Capon, of Toronto, Canada.

**Application.** While the application of such crowns is necessarily confined to repair work, they are equally applicable to cases where the original crown possessed a band and cap, which may or may not remain securely in place, as well as to those where no band was used, so long as the dowel itself remains; but the strength in the attachment of the new crown will of course depend upon the length of the end of the dowel exposed and projecting beyond the surface of the cap, or root, which may be telescoped by the tube.

When this is inadequate the opportunities for securing sufficient integrity may be increased by drilling out the cement around the dowel, and thus trephining its end, with a small round bur, until a greater length is exposed; but where a cap remains, unless the dowel projects sufficiently far beyond it, such access and possibilities may indicate its destruction and removal.

When the dowel has been thus exposed so as to insure sufficient stability in the attachment of the crown, its end should be squared up and properly shaped to admit of, and facilitate, the adaptation and *easy removal* of a telescoping tube. (Fig. 177, A.)

**Procedure.** This tube should be made of pure gold or platinum, about 36 gauge, and may be formed on a piece of wire previously selected for the purpose, and a trifle larger in diameter than the dowel; or *foil* may be used and adapted directly to the dowel, if subsequently reinforced with solder; which should be also observed even in the former.

When made and fitted, the joint should be soldered, and the tube then adjusted to the dowel. A disk of pure gold or platinum, as the requirements of the intended construction may indicate, about 36 gauge, should now be perforated to fit closely over the tube, burnished to a close adaptation to the root, and trimmed to follow its peripheral outline. The surplus end of the tube should now be cut off even with the end of the dowel, and the proper relation between it and the disk securely sustained with adhesive wax, when they may be detached from the root and invested and soldered, at which time the open end of the tube presenting

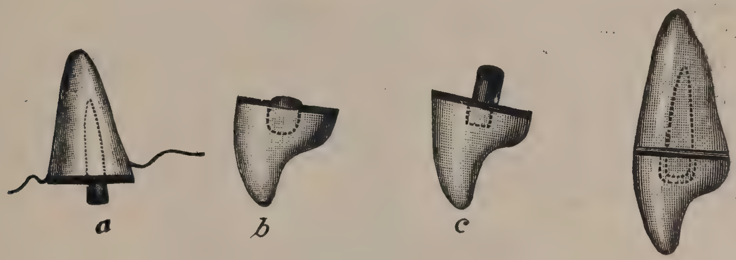



Fig. 177.

toward the incisal edge should be closed. This affords an accurately adapted base for the subsequent construction of a crown in the ordinary manner, using a facing in combination with either gold or porcelain, which may then be finished and mounted with cement.

The completed crown for that class of cases where the end of the dowel projects far enough beyond the base of the root to afford adequate stability in the attachment is illustrated in Fig. 177, B; while the construction for those cases wherein the end of the dowel is trephined and the tube thus extended into the root, as a means of securing greater integrity, is illustrated in Fig. 177, C, and the relation of the finished crown to the root and dowel in the *former* class is illustrated in Fig. 177, D.

## Temporary Crowns.

The employment of temporary crowns become necessary in *emergency* cases where *immediate* substitution of the lost natural, or broken artificial, crown is required; and is indicated in the construction of per-

manent crowns *for the anterior teeth*, for the purpose of relieving the patient of temporary disfigurement and embarassment during the procedure. Their use also materially facilitates the subsequent adjustment and mounting of the permanent crown by keeping the gum packed away and preserving a free exposure of the end of the root, during the interim.

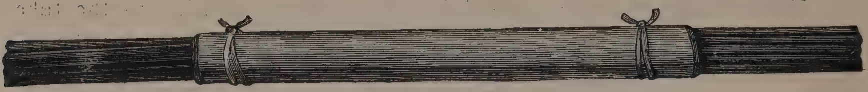


Fig. 178.

**Indications.** In view of the possible advantages thus derived from their use in the application of dowel crowns, and particularly in the mouths of women, they should be invariably employed whenever the time required to complete the construction of a permanent crown precludes finishing and mounting the latter on the same day on which the root is prepared.

While almost any of the fixed-dowel crowns, and especially the less expensive ones, will often answer this purpose, and even the old-style English tube-teeth may be employed, the most simple, expeditious and inexpensive method consists in using an ordinary long-pin facing, and constructing the crown for the individual case.

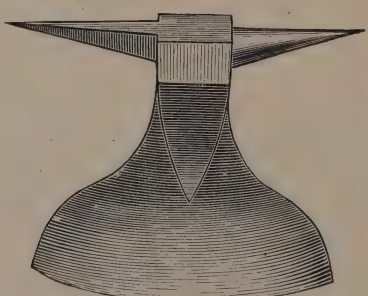


Fig. 179.

**Procedure.** To facilitate the application, at least a small selection of facings for the six anterior teeth should be kept on hand. One suitable to the requirements of the case in size, shape and color, should then be selected and ground to a fairly good adaptation, and a dowel then made of German-silver wire. Such wire is convenient for many purposes and may be easily procured in six-inch lengths of various sizes from jewelers' supply houses. Fig. 178.

A proper length and size of dowel should be cut, one end slightly tapered with a file, and the other flattened with a small hammer on the anvil, Fig. 179, or by pressing between rollers, Fig. 180, both of which are useful appurtenances for the well equipped laboratory, until it is broad enough to fit in snugly between the pins. This is done for the purpose of facilitating the attachment of the facing, and preventing any obstruction to the occlusion, but should not be done with a file, because of thus unnecessarily diminishing the strength of the dowel at this point.

The most convenient method of attaching the facing and dowel has been suggested by Dr. W. H. Taggart, of Chicago, Ill. In this pro-

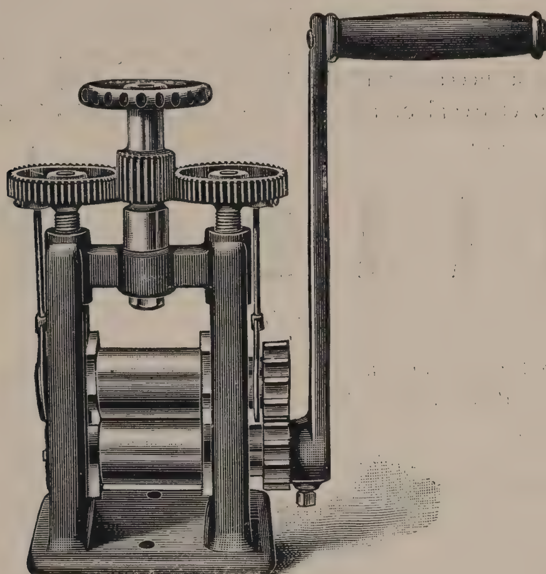


*Fig. 180.*

cedure the flattened end of the dowel is made somewhat broader than the space between the pins of the facing, and then *notched* with the edge of a file until it may be slipped into place, with the pins fitting closely into the notches. The permanent relation between the two may then be securely sustained by bending the pins over upon the dowel.

The dowel should now be bent, if necessary, until the crown may be properly adjusted to position on the root, when it should be mounted with temporary stopping or gutta percha, with which the desired contouring of the lingual surface can also be made. The consecutive steps of this entire procedure are illustrated in Fig. 181.

Temporary stopping may be used with greater facility and possesses sufficient integrity to serve the purpose for a few days, but when the crown is to be worn for a longer, or more indefinite period, gutta percha should be used.

Although the detail incident to the construction of such crowns consumes but five or ten minutes' time, an assortment of these dowels may be made at convenient opportunities, and kept for subsequent use, which will further expedite the work.

The relation between facing and dowel may be also sustained by the use of either *hard* or *soft* solder, if desirable, but a more secure attachment than is afforded by the above method is seldom, if ever, required.

In the use of gold or silver solder for such purposes the facing and dowel should be attached by bending the pins, and the whole then *invested* and soldered in the usual manner. In using soft solder, however, no investment is necessary if the facing and dowel are placed upon a slightly heated charcoal or asbestos block or in a bed of asbestos fibre;

*Fig. 181.*

the proper flux then applied, and evaporated with heat, and the solder then fused by slowly directing the flame of a Bunsen burner or alcohol lamp upon the facing.

**Use of Amalgam.** A more artistic and finished contour of the lingual surface, as well as a more permanent adaptation of such crowns may be obtained by placing the facing and dowel (after their attachment) upon the root, and packing plastic amalgam over its end, and around the dowel, to the desired contour. After this has crystallized, it may be finished and polished, and then mounted. This procedure consumes more time, and entails more work than is usually indicated or warrantable for *temporary* purposes.

**Use of Vulcanite.** More artistic and permanent results may also be obtained by adapting the base and forming the lingual contour with wax, and subsequently flasking the crown and replacing the wax with vulcanite. In the process, however, it becomes necessary to *"tin"* the German-silver dowel, so that the vulcanite may become attached to it, and the entire procedure requires more time than that incident to the construction of a crown in a more practical and artistic manner.

# Application and Construction of Porcelain Crowns.

CHAPTER XII.

Contraindications. Indications. Advantages: Esthetic; Anterior Crowns, Bicuspid Crowns, Molar Crowns. Hygienic. Mechanical; Attachment of Facing, Attachment of Molar and Bicuspid Crowns to Root. Application: Requirements; Strength of Metal Construction, Soldering, Oxyhydrogen Flame, Root Preparation. With Band and Dowel; Bands, Floor, Dowels, Accurate Fitting Dowels, Impression and "Bite," Facing, Investment, Soldering Facing, Anterior Crowns, Bicuspid Crowns, Molar Crowns; With Facing, Without Facing. Variations in Construction: Re-enforced Caps; Procedure. Without Band; Procedure, Plate and Dowel. Partial Bands; Procedure. Jacket Crowns; Indications for Porcelain Jackets, Procedure. Variation of Method. Use of the Davis and Logan Crowns; Advantages, Disadvantages. Application of the Davis Crown, With Band, Without Band. Application of the Logan Crown; Procedure.

After having passed through the various experimental stages incident to the development of its possibilities, the application of porcelain work, or the *ceramic art* has opened one of the most artistic and practical fields of dentistry, and is without doubt destined to become a permanent part of modern practice.

While the primitive efforts in this line were fraught with many discouraging phases, and replete with failures, and much of the resultant development must be attributed to the ever-increasing and constantly improving facilities; yet, throughout the entire era of its employment, from the time when the material was supplied in only one or two grades and colors; when the *coke* furnaces afforded the only adequate means for obtaining sufficient heat, and when the "baking" of a case required considerable effort and consumed much time, until the present, when it can

be procured in several grades and in varying colors; when the same procedure may be accomplished in the operating room in the presence of the patient, instead of the laboratory, at night; and at the expense of but little time or effort, the *possibilities* of such work from an *artistic* point of view have always been fully appreciated.

Since porcelain is a *mineral* substance, however, and in consequence possesses the characteristic of *friability,* the possibilities from the viewpoint of *strength*—which as a requirement is of equal importance with the esthetic—have been observed and recognized only in its more modern application; and have been attained mainly as the result of continued experimentation on the part of those who were sufficiently enthusiastic and progressive to ascertain the causes of failures, and endeavor to overcome them by the elimination of weak points.

As a result, the use of porcelain in its present form, and with the facilities available, make it possible for the skilful and experienced operator to achieve results which combine both of these requirements to a high degree. This is especially true of its application to crown and bridgework, in which its conservative employment may be productive of a class of work which more closely approaches the *ideal* than any other, by conserving the very highest possible esthetic and mechanical requirements.

In view of the *friable* nature of porcelain, however, the desired and necessary degree of strength is *not* to be obtained from *thin* layers, or *veneers,* but is dependent upon the presence of a sufficient thickness to insure the requisite resistance to stress. For this reason the possible strength of such work will naturally increase in proportion to the quantity which may be used in the individual case, *or in proportion with the bulk;* and for the latter reason, porcelain work in any of its phases is not universally applicable, but, on the contrary, has its definite prescribed limitations.

Hence the entire practicability of this class of work will depend upon, first, *conservative* or *judicious application,* and second, a *skilful execution* of all of the details incident to the construction.

The absolute necessity for scrupulous attention to detail, and for the utmost of painstaking care in its execution accounts to a large extent for the occurrence of failures, and elevates this class of work to a plane somewhat beyond the ordinary. Indeed, the successful manipulation of porcelain promotes and demands the acquirement of a degree of skill, and the cultivation of an artistic temperament, which is far beyond the province of those whose efforts are more or less encompassed within the range of indifference.

While failures will occur in any line of work, a very large proportion

of them in this particular class can invariably be attributed to an inadequate conception of the requirements, or *injudicious application;* or to unskilful or faulty construction and manipulation; either, or all, of which should reflect upon the inexperience or indifference of the operator rather than to cause or result in a premature condemnation of principles, methods and materials involved.

## Contraindications.

For these apparent reasons the application of porcelain to the construction of *individual crowns,* to which consideration this chapter will be exclusively devoted, is contraindicated in all cases where the maximum length of the crown, or the close occlusion of the opposing teeth, precludes the presence of porcelain in *sufficient* thickness, or *bulk, to insure an adequate degree of strength;* and where nothing but an indestructible substance, like metal, could be relied upon to withstand the stress of mastication.

## Indications.

As such cases present the *exceptional,* rather than the usual conditions, however, and hence constitute a small percentage of those requiring a restoration of the natural crown, the application of porcelain crowns, properly constructed, is especially indicated on the ten anterior teeth, and not infrequently upon the molars, in all cases which present a *normal* or *average favorable occlusion.*

## Advantages.

The special advantages to be obtained from the application of porcelain crowns lie in the artistic manner and facility with which the natural conditions and varying characteristics may be closely simulated; the hygienic qualities of the material, and the possibilities for comparative and relative strength. These may be classified as *esthetic, hygienic* and *mechanical* and each will be separately considered.

**Esthetic.** While the possibilities for avoiding any display of gold are always very advantageous this esthetic feature is further supplemented by the absence of a metal backing, the use of which particularly on the anterior teeth is always more or less objectionable.

**Anterior Crowns.** In the construction of crowns for the six anterior teeth the reflection of the rays of light and its variations bear materially upon the color problem, and more artistic results are always to be obtained from the absence of a metal backing for the reason that its presence *destroys the translucency of the porcelain facing; changes its color,* and often occasions the appear-

ance of a dark blue line along the point between facing and backing. This latter unsightly and unhygienic condition is due to the penetration and decomposition of secretions, and is of course decidedly objectionable. While the translucency of the facing is slightly diminished even in a porcelain crown, it is by no means *destroyed,* and the other objectionable features are entirely eliminated, all of which are, particularly in this region, especially important considerations.

**Bicuspid Crowns.** In the restoration of the crowns of bicuspids the employment of porcelain is especially indicated because of the difficulty of obtaining the same esthetic effect, combined with the required degree of strength, in any other style of construction. Indeed the ease and facility with which both of these features may be obtained, as compared with any other style of crown, causes its application to be pre-eminently indicated on these teeth.

**Molar Crowns.** Although color and translucency are not so essentially important a consideration in crowning the molars, and granting the previously mentioned advantages of the gold shell or telescope crown for these teeth, there are nevertheless frequent indications for the application of porcelain crowns. Often on the *first,* and occasionally on the *second* molars, and particularly in the mouths of women, gold crowns are more or less conspicuous, and the use of porcelain may serve a highly esthetic purpose in these cases.

**Hygienic.** The hygienic properties of a smooth, highly vitrified surface, like that which presents in porcelain, constitute an important advantage of inestimable value in the mouth. Such a surface is more easily kept clean than that of gold because it is immune to the chemical action of the secretions, and food products will not cling to, become deposited upon, or be absorbed by it. For this reason, and possibly also because of its property of slow conductivity, it is least irritating to, and most compatible with, the tissues of the mouth.

**Mechanical.** Those advantages which have been classified as *mechanical* will be considered from the view-point of the relative degree of possible *strength* which may be obtained both in the construction of the crown, and in its attachment to the root.

**Attachment of Facing.** As the attachment of the facing is usually the weakest point in the construction of dowel crowns, in this connection the relative strength to be obtained from this style of construction as compared with a metal backed crown is a matter of much concern and of appreciable importance.

The probability of the subsequent occurrence of fractured facings in porcelain crown work is reduced to a minimum for the reason that, in a metal backed crown the facing is attached to the backing simply and only by means of the attachment pins, while, in a porcelain crown, this same attachment is also secured and then further supplemented by the fusion of the porcelain over the entire lingual surface of the facing.

The additional strength thus obtained by this combined means of attachment makes it practically impossible for the facing to be broken away from a well constructed crown. When such breakage or accident does occur, the entire mass of porcelain, including facing, will usually separate from the cap, which rarely happens, and which can be quite as often attributed to, and invariably indicates, faulty construction of the crown with regard to the means observed for the support and retention of the porcelain.

**Attachment of Molar and Bicuspid Crowns.**

In the attachment of molar and bicuspid crowns to the root a *possible* mechanical advantage is also possessed, even over gold crowns, because of the greater facility with which a *short* projecting end of the root *may* be properly prepared, and a *narrow* band accurately fitted, as compared with the requirements incident to shaping a longer projecting end of the root and adapting a wider band.

While the latter procedure may be somewhat more difficult, any possible advantage reverts, however, to the degree of skill with which the detail is executed, and unless the *esthetic* requirements indicate the application of a porcelain crown, or the root is primarily destroyed to a close proximity with the gum line, the preference should usually be given to the gold crown because of the conservation of tooth structure, and of the increased strength in the attachment between crown and root which may possibly be obtained in the use of a wider telescoping band.

## Application.

In the application of this class of crown construction the highest possible advantages can be derived only from a careful observation of the requirements, combined with a skilful execution of the details in the preparation of the root; the construction and adaptation of the cap, and attachment of the facing; and the manipulation of the "body" itself.

When the conditions of occlusion are, or may be made, favorable, and when these details of construction have been executed with skill, a porcelain crown possesses adequate strength to meet the requirements in all average and typical cases; and the possible integrity in such work often exceeds that of any other style of construction.

**Requirements.**

To obtain such results with a maximum degree of strength, however, *three* essential requirements must be observed: First, the cap, or base, of the crown must be inherently *strong* enough to *retain its shape,* and afford ample means of *attachment* and *support* to the porcelain. Second, the facing must be *properly adapted,* and *securely attached* to the cap; and third, the selection and manipulation of the "body" must be made with a view to securing the best possible results.

**Strength of Metal Construction.**

In order that the requisite strength may exist in the metal parts they must be made of a material which will withstand the degree of heat required to fuse the porcelain; and a gauge sufficiently thick to retain its given shape must be used. Because of the practical infusibility of platinum, of its malleability, slight susceptibility to oxidation, and to the chemical action of the secretions, it is used almost exclusively for all of the parts for this work, excepting the dowel. For this purpose the alloy of platinum and iridium is used because of the softness of platinum alone, and of the additional stiffness imparted by the incorporation of various proportions of the latter metal.

**Soldering.**

In soldering the various parts *perfect contact* between all joints to be united should exist, and their union must be effected with a grade of solder which will not be *disturbed* or *re-fused* in the subsequent "baking" of the crown. For this reason 25% platinum solder should be used throughout the entire assemblage of metal parts if the *greatest degree* of strength is to be obtained, and its use is *absolutely necessary* wherever contact does *not* exist.

In the construction of single crowns, however, all of the soldering may be done successfully with the use of *pure gold* as a solder, *provided* that *absolute contact* of the parts has been secured, and that the gold is then *thoroughly fused* until all surplus *disappears* by becoming *absorbed by,* and *alloyed with,* the platinum.

This may be easily accomplished by the *continued* application of a small pointed flame from the ordinary combination mouth blow-pipe, and will be indicated by the disappearance of the surplus, and the blending of its color into that of the platinum. To secure this result with facility, however, it is highly important that only enough gold should be used to make the joint, and such a union will possess strength, and successfully withstand the degree of heat necessary to fuse the porcelain.

Should absolute contact not exist at any point in the joint the disappearance of the pure gold solder, which may be due either to absorption or to volatilization, will result in a subsequent opening and weakening of the joint, either from the heat of the blow-pipe or furnace.

**Oxyhydrogen Flame.** In the use of platinum solders, whether or not an investment is employed, the use of the oxyhydrogen flame is expedient, and often absolutely essential, and while the same might also be used with pure gold, it is entirely unnecessary.

As those requirements incident to the attachment of the facing, and the manipulation of the body, constitute important procedures in the construction of the crown, they will be considered in regular order.

**Root Preparation.** The requirements of root preparation are similar to those previously indicated in the application of any of the various styles of dowel crowns, with the exception that, for porcelain work, the root should be cut down until as *short as consistent* in order to secure as much space, and make as much accommodation for the porcelain as possible.

While an unnecessary waste or sacrifice of tooth structure is to be condemned as a general practice, for the above reason the root should be cut shorter for porcelain crowns than for any other style of construction, but, *if a band is to be employed a projecting* surplus end should always be allowed to remain until the *peripheral trimming* has been accomplished, the *measurement taken,* and the *band fitted.* This is necessary for the reasons previously mentioned in connection with the "band and dowel" crown, and the same shape is indicated for the basal end of the root as formerly recommended and illustrated for anterior roots in Fig. 50, and for bicuspid and molar roots in Fig. 53.

## With Band and Dowel.

As the employment of a band is generally conceded to be productive of the most universally successful results, this style of construction will be given precedence in this consideration, and be followed by the variations, the indications for the application of each of which having been previously mentioned.

**Bands.** The band should be made of platinum not thicker than 28 nor thinner than 29 gauge, and the edges should be slightly overlapped before soldering. This method should be observed as a means of securing additional strength, and of precluding the subsequent opening of the joint from the expansion of the metal which is induced by the degree of heat necessary to fuse the porcelain. The *exact* length of the measurement of the root, taken in the ordinary manner, and cut and straightened as indicated, should be designated by cutting a small nick in the edge of a piece of platinum plate from which the band should then be cut about ⅛ of an inch wide, and with an allowance of about 1/16 of an inch surplus. (Fig.

182 A.) Each end should then be slightly beveled *on one side* with a file, and the band then annealed and made in circular form, with the surplus end, designated by the nick, *overlapping the outside* of the other end until the nick approximates evenly with this edge. (Fig. 182 B.)

The surplus overlapping end must be on the *outside* to prevent diminishing the size of the band, and the relation may then be sustained by pinching the ends closely together with flat-nose pliers, which produces a sharp angle on each side of the joint and affords a flat surface contact. (Fig. 182 C.) This will usually overcome a change in the relation as the result of expansion when heated, though a wire may be twisted around the band for this purpose if necessary.

The joint should then be soldered with a *minimum* quantity of 25 per cent platinum solder, or with pure gold, to prevent unnecessary stiffness, in the manner indicated.

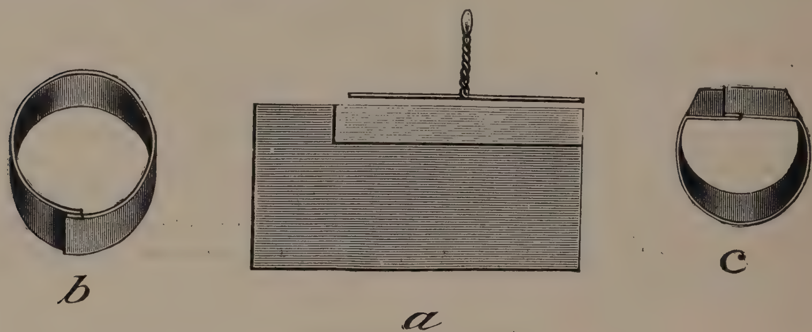



Fig. 182.

The band should now be trimmed to follow the cervical curvature of the gum, the edge nicely *rounded,* and then fitted to the root, and afterward cut away until *as narrow as possible,* in accordance with the detail previously described.

**Floor.** The floor should be of about 32 gauge platinum cut somewhat larger than the diameter of the band. The band should be placed in position on it, and first simply *tacked* to place with a small quantity of solder. This primary attachment secures the relation and *anneals* the floor metal so that it may then be easily burnished into *close* and *direct contact* with the edge of the band, without danger of changing the shape of the latter.

The soldering may now be completed in which, if pure gold is used, it must be carefully noted that perfect contact exists around the entire joint, after which the surplus may be trimmed away and finished down with file and disks until flush with the edge of the band.

**Dowels.**

The dowel should be made of *round iridio-platinum wire* of a size proportionate with the size of the root and requirements of the crown, and fitted to the canal in the manner previously outlined.

The cap should now be adjusted to place on the root, the floor slightly perforated for the dowel at the proper point, and this perforation then *enlarged with the dowel* by forcing it to place. This insures a perfect contact between them which is essential to the strength of their union, and to the facility with which it may be accomplished.

The relation should now be temporarily sustained with gutta-percha or adhesive wax, until they may be removed, invested, and soldered as indicated. While any means of investment is often unnecessary because of the close relation thus existing, the simple means previously advocated for this *insures* their proper relation.

**Accurate Fitting Dowels.**

Where it may be desirable to have the dowel fit closely to the walls of the canal throughout its entire length, the method suggested by Dr. A. O. Hunt, and others may be used to advantage. This consists in rolling platinum foil 1-1000 into a cone, passing this cone into the canal and expanding it first with a tapering pointed instrument, and then by packing cotton into it, until it conforms to the shape of the canal. It may now be removed and filled with *platinum solder*, and then adjusted to its proper relation with the cap, as indicated.

The same procedure is also applicable to any kind of crown construction, and for gold work the cone may be filled with scrap gold or solder.

While iridio-platinum wire of a suitable size will usually meet all of the requirements of a dowel, one constructed in this manner possesses the advantage of being *largest* at the *junction between crown and root* which is of course the weakest point in the attachment of any kind of a dowel crown; and the use of such a dowel may be especially indicated in those cases where the canal has become abnormally enlarged from decay.

**Impression and "Bite."**

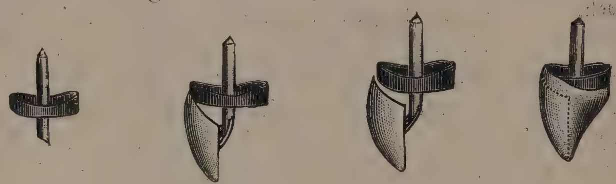
When the cap has been completed and finished, and adjusted to its proper position on the root, the usual impression should then be taken in plaster, and this *preceded*, whenever necessary, by a "bite" in wax.

After securing the impression, it should be observed that the cap rests firmly in place in it, and, if necessary, it should be sealed with hot wax. The interior of the band and surface of the dowel should then be covered with a thin film of melted wax, to facilitate its removal from, and admit of its accurate readjustment to, the model.

This is of paramount importance in this class of work, because of the necessity for frequently trying to place on the model during the construction of the crown, and particularly in those cases requiring a restoration of occlusion.

**Facing.** The facing should be selected in accordance with the requirements of color and size, and ground to conform with the desired shape and characteristics. As the color is more likely to be *slightly bleached* instead of becoming *darker,* if any variation is necessary or unavoidable, it should invariably be darker than lighter, though the best makes of porcelain teeth rarely change to any appreciable extent if the proper make and color of "body" is placed back of them, and properly fused.

In this connection, it is necessary to use a "body" the fusing point of which will not affect the color of the facing, as an example of which the use of the higher fusing American "bodies" in combination with the English make of facings will entirely destroy the color of the latter.



a b c d

Fig. 183.

In grinding the facing, the edge of the cap should previously be nicely *rounded* with disks (Fig. 183, A), and the cervical end of the facing then ground *thin* to admit of overlapping upon the labial or buccal edge of the band without causing undue prominence at this point. (Fig. 183, B.)

This is necessary as a means of bringing the edge of the facing into close proximity with the gum, and for the purpose of thus affording a *mechanical retention* to the porcelain with which this portion of the band should invariably be *completely covered.*

If the platinum band is not entirely covered upon this surface, it will always show through the thin transparent tissue, and occasion the presentation of a dark blue line, at this point.

As this is a decidedly inartistic and *undesirable* feature, and as there is *no physical union between porcelain and platinum,* the overlapping of the facing affords a secure mechanical retention for a sufficient quantity of porcelain to cover this portion of the band and overcome this possible objection, and result in a smooth flush joint in the finished crown.

Wherever it is desirable to retain porcelain in contact with platinum, some similar means of affording mechanical retention is always necessary, and this may be further facilitated by allowing a very slight space to exist between facing and cap. (Fig. 183, C.)

When the facing has been thus properly adapted, it should be sealed to place on the cap with adhesive wax, and the whole then detached from the model and invested.

**Investment.** In investing, only enough material should be used to surround the crown nicely and afford sufficient strength in the investment; and when the material has crystallized, all surplus should be trimmed away until the *entire lingual surface of the facing is freely exposed.* (Fig. 184.)

This free exposure is necessary as a means of facilitating the soldering, and it may be made without increasing the danger of fracturing the facing, if the case is then *adequately heated* before attempting to solder.

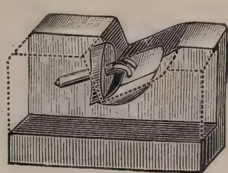


*Fig. 184.*

**Soldering Facing.** Before heating the case *the pins should be bent down toward the porcelain* until their ends may be brought into *absolute contact* with the metal parts. This may be done by holding the facing firmly in place with a blunt-pointed instrument in one hand, to prevent displacing it, while another instrument, held in the other hand, may be placed against the *extreme ends* of the pins and sufficient pressure applied to bend them into the desired relation.

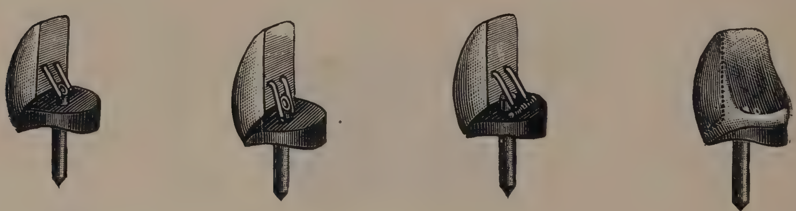
**Anterior Crowns.** While it is always desirable to get the pins down *close to the facing,* and thus make more room for the porcelain, and still have an equal degree of strength in their attachment, this is especially indicated in the construction of anterior crowns.

In these crowns the pins should be bent down close to the porcelain, and their ends brought into contact with the surplus end of the

dowel *at a point as close to the floor of the cap as possible* (Fig. 185, A), or in direct contact with the floor itself. (Fig. 185, B.)

This is important, because it affords opportunities for the same degree of strength in their union with the cap, and yet adds to that of the crown by getting the metal parts out of the way, so that they will not *divide* the porcelain through the center, or interfere with the proper and desired contour of the lingual surface.

In cases where the ends of the pins will not reach to the floor, or dowel, the space between them and the floor, after being bent down toward the porcelain, may be filled in with one or two thicknesses of platinum plate, or wire, if necessary, until *continuous contact* may be secured, as illustrated in Fig. 185, C. The finished crown, showing the possibilities of contour, strength and artistic effect, is illustrated in Fig. 185, D.



*a* *b* *c* *d*

*Fig. 185.*

**Bicuspid Crowns.** As there is no physical union between porcelain and platinum, in the construction of bicuspid crowns, it is not only desirable to make as much space for the porcelain which is to form the entire lingual surface of the crown, as possible, but it is also often necessary to provide some means for supporting it against any possible line of *cleavage,* in order to preclude subsequent fracturing of this mass of porcelain from the stress of mastication.

This support to the porcelain, and destruction of the line of cleavage, may be best and most easily accomplished by soldering a narrow band of platinum to the floor of the cap, about one-sixteenth of an inch *inside* of the edge of the band. This *should be fitted before heating the case,* and may be attached at the time of soldering the facing, and its presence thus forms a cup-shaped support which admirably answers the pur-

pose for which it is intended, without showing through, or materially weakening, the porcelain. (Fig. 186, A.)

Another means of accomplishing the same end has been suggested by Dr. Capon, and consists in adapting and attaching a band around the *outside* of the entire lingual surface of the cap, from one side of the facing to the other, and projecting about one-sixteenth of an inch beyond the floor. (Fig. 186, B.) This method retains and supports the porcelain in a splendid manner, but is much more difficult to adapt, and detracts somewhat from the artistic effect obtained in the finished crown.

The same result may also be obtained by attaching a small vertical extension of *round* platinum wire to the *immediate center* of the lingual portion of the cap. (Fig. 186, C.) Or, when two dowels are used, the surplus end of the lingual one may be so employed. (Fig. 186, D.)

Unless in the latter instance this is somewhat difficult to hold in its proper place while soldering, and may prove an element of weakness instead of strength, if not properly adjusted. When this procedure is observed in either instance the extension of wire should be in the *exact center,* not project over one-sixteenth of an inch beyond the floor, and the extreme end always well *rounded.* The finished crown is illustrated in Fig. 186, E.

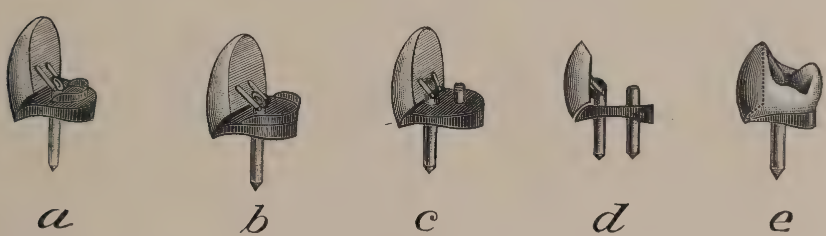


Fig. 186.

**Molar Crowns.**

In the construction of molar crowns, *two* methods are employed. One consists in using a facing and observing similar details to those indicated in the construction of bicuspids, and the other in making the cap, and building the entire crown of porcelain without a facing.

**With Facing.**

While it is true that the requirements of color are not quite so important in molars, the best results will usually be obtained from the use of a facing whenever possible, for the reason that both the form and color of the visible parts of the crown are obtained and preserved in the facing.

When a facing is used, the construction should be made, as indicated for bicuspid crowns, and illustrated in Fig. 187, A, and Fig. 187, B shows the finished crown.

**Without Facing.** In very close "bites" the use of a facing may often be contraindicated, and the best results obtained by simply making the cap and forming the entire crown with porcelain. For such cases the porcelain should be supported by any of the means indicated, the variations of which, together with the finished crown, are illustrated in Fig. 188.

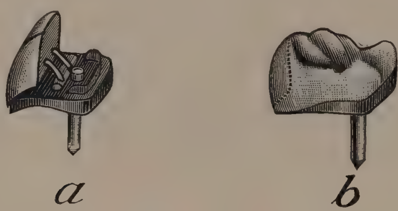



*Fig. 187.*

Additional mechanical means for obtaining, or aiding in, the attachment of the porcelain to the cap may also be secured in any of these various styles of construction, by *roughening* or *spurring* the surface of the platinum with a sharp-pointed instrument. This latter method is employed exclusively by some, and may serve the purpose in large crowns,

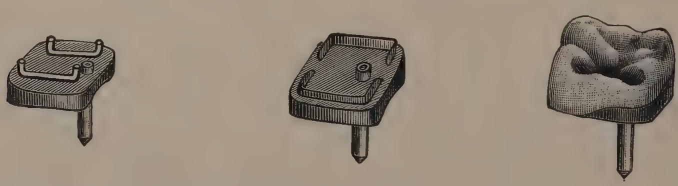


*Fig. 188.*

where considerable surface is exposed, without being supplemented by any of the former means.

## Variations in Construction.

Because of the acknowledged advantages of a band, the foregoing style of construction has been given precedence, and designated as the *typical* one; yet, while it is true that crowns so made are perhaps more universally applicable, and productive of more permanent results, it is also true that there are many variations of methods of more or less value, the employment of many of which may be frequently indicated.

## Reenforced Caps.

As inherent strength in the metal parts has already been claimed as a *prerequisite* in this work, one of the most useful variations in the construction is to be obtained by reenforcing the cap in a manner similar to that previously recommended in the construction of crowns with the so-called saddle-back teeth.

Such a procedure imparts to the finished porcelain crown a degree of strength which is appreciably valuable in many cases; particularly in bicuspid crowns, and in those cases where the crown is not supported by adjacent teeth on one or both sides, and where the absence of some of the opposing teeth necessitate more than average occluding stress.

This increased strength may be secured by allowing the floor to project slightly beyond the band upon the approximal and lingual surfaces, and then filling in the shoulder so formed with platinum solder until smooth and flush. The additional thickness of a cap so made further pre-

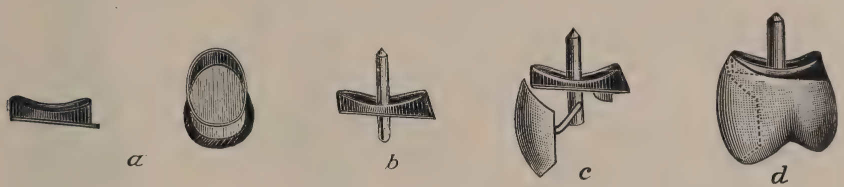


*Fig. 189.*

cludes the possibility of subsequent irritation to the surrounding tissue by affording a heavier, smoother and more rounding edge.

**Procedure.** In accomplishing this result, the procedure incident to the fitting of the band and construction of the cap is identical with that indicated in the preceding method, except that platinum solder should be used.

When the floor has been attached to the band, the surplus should be trimmed away until a projecting edge, from 1/16 to 1/32 of an inch, remains upon the *approximal* and *lingual surfaces*. The labial or buccal surface, however, must be trimmed flush and even with the band, in order to prevent an undue prominence of the neck of the facing, and to admit of properly overlapping it upon this surface of the band, both features of which are illustrated in Fig. 189, A.

The slight shoulder so formed should be filled in with 25 per cent platinum solder, until flush and even with the band, the edge then nicely rounded and the dowel fitted and soldered as usual. (Fig. 189, B.)

The completed cap, with the proper relation of the facing, is shown in Fig. 189, C, and the finished crown, with its apparent advantages, in Fig. 189, D.

## Without Band.

That style of construction which involves simply the adaptation of a metal floor or base to the end of the root, and the attachment of a dowel and facing thereto, and which has previously been designated as the "plate and dowel" crown, is equally as applicable to porcelain work as to gold work.

**Procedure.** The indications and general principles, and the detail of procedure incident to the requirements of root preparation, and the construction of the base of the crown, are identically the same as previously outlined. The only exception is the variation which the completion of the crown with porcelain "body" instead of gold solder demands, and which includes the use of platinum and high-grade solder.

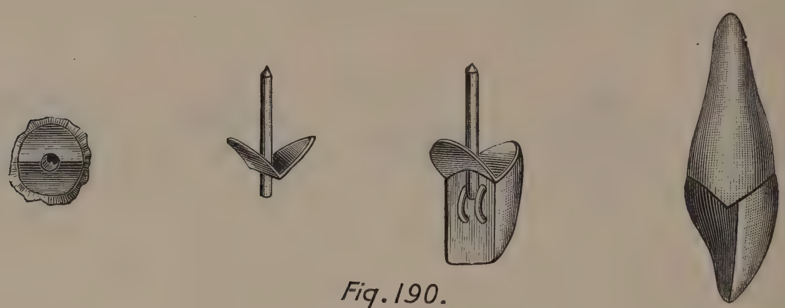


Fig. 190.

**Plate and Dowel.** Wherever a band is not desirable, for any reason, or where its use may be contraindicated, and the preference given to this style of construction, a plate of platinum about 36 gauge should be adapted to the end of the root, by burnishing or swaging, as indicated in Chapter X.

The dowel should then be soldered; the cap again adjusted to the root, and reburnished and properly trimmed around the edge, the models secured, and the facing attached by observing the requirements indicated in the immediately preceding style of construction, as are consecutively illustrated in Fig. 190. If the presence of this thin plate of platinum should be objectionable or conspicuous, it may be afterward removed by destroying its attachment to the dowel with a small round bur, carefully inserting the edge of a thin knife blade between it and the porcelain on the lingual surface, and gently lifting it away from the base of the crown. A slight deepening of the canal, or shortening of the dowel, will allow for its absence, and admit of placing the crown in close proximity with the root.

## Partial Bands.

The employment of a partial band encircling only the approximal and lingual sides of the root, as a means of increasing the stability of the attachment of the crown, may also be made in a manner similar to that already mentioned.

As this style of construction serves to fortify the crown against stress in the direction in which it is usually imposed, and also renders this porton of the joint between crown and root more or less immune to the penetration of secretions, it at once recommends itself as a useful practice, especially indicated on the six anterior teeth, where the root is allowed to project slightly beyond the gum line on the lingual side.

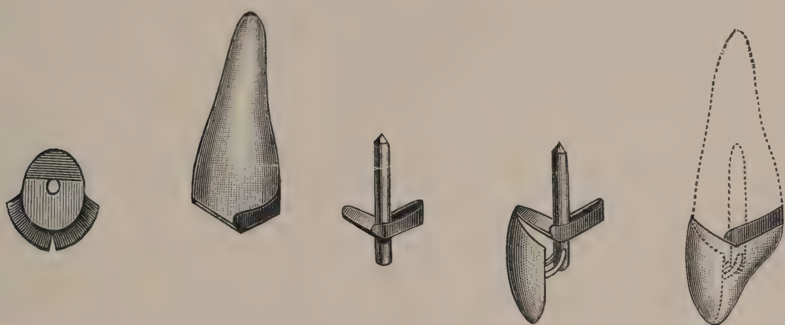


*Fig. 191.*

**Procedure.** The effect of a partial band to serve such purposes may be obtained with the greatest degree of facility by allowing a sufficient surplus of the plate to extend beyond the root on this surface, until the adaptation of the base has been secured, and the dowel soldered.

The cap may now be adjusted to position on the root, where it is held firmly by the presence of the dowel, and this surplus edge then burnished up close to the surface of the root, and finally trimmed to follow the curvature of the gum.

A surplus sufficient to admit of reaching the gum line, and passing just a bit beneath it, should always be allowed to remain, and if the accurate burnishing of this upturned edge is made difficult because of the length of the root, a slight incision through the surplus edge of the plate at the center of the lingual surface will facilitate the possible adaptation. This may be subsequently soldered, either before or after the impression has been taken, but should always be done before the porcelain

is applied. More than one incision may be sometimes indicated, and are permissible when necessary.

The various steps in this style of construction are consecutively illustrated in Fig. 191.

## Jacket Crowns.

The principles involved in the so-called "jacket" style of crown construction, as applied to both gold and porcelain work, have been elsewhere considered, together with the indications, advantages and disadvantages governing their application.

The practicability of these crowns, however, when made in combination with porcelain, is apparently a question of much dispute, and has continued to be since the method, which was the primitive effort in the line of constructing porcelain crowns in combination with platinum, was first suggested by Dr. C. H. Land.

The advocates of this style of construction claim that it is more or less universally indicated in restoring the crowns of the six anterior teeth, upper and lower; and that the principal advantage lies in the conservation of tooth structure, and the preservation of the pulp.

While both of these considerations are always of material significance to the conscientious operator, and should be observed wherever possible, still they do not constitute the complete maximum of requirements of crown construction and application, even when combined with the highest esthetic possibilities, because the requirement of *strength* is, of course, of equal importance, having so great an influence upon the serviceability and permanency of the work.

In view of this fact, and also that the projecting end of the crown of the natural tooth, which is to be telescoped by the cap or "jacket," as a means of affording attachment for the artificial crown, is allowed to remain, or is preserved, at the expense of the thickness of porcelain which may be subsequently used in the construction of the crown; and, because of the *friable* nature of porcelain, particularly when used in small quantity, this style of construction is not to be recommended as a general or conservative practice, and is by no means universally applicable, if the most permanent results are desired.

In this connection, it seems more than probable that a large percentage of the early failures which marked the advent of the porcelain crown constructed for the individual case, and retarded the development of this work, may be attributed as much to the method of construction as to the use of the *low fusing bodies,* which were formerly employed.

Aside from the inherent weakness, which adequate accommodation

for the root in the body of the crown demands, the artistic possibilities are also often somewhat hampered by the more or less clumsy appearance of the finished crown.

**Indications for Porcelain Jackets.**

Whenever *an adequate length of the adjacent teeth,* and a *favorable occlusion,* will admit of overcoming these objectionable features, and securing a maximum degree of strength, jacket crowns may be constructed with porcelain, producing serviceable and artistic restorations.

**Procedure.**

In the application of this style of crown, the remaining natural crown should be favorably shaped to admit of the accurate adaptation of the jacket, and of the proper alignment of the facing, as indicated in the previous consideration, and illustrated in Fig. 192, A.

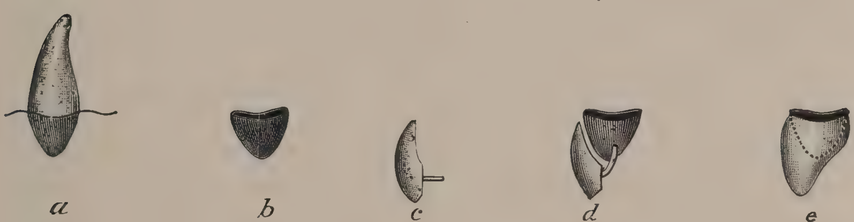



*Fig. 192.*

The measurement should be taken and a band of about 36 gauge platinum, wide enough to encompass the entire remaining natural crown, then made. The overlapping of the ends in this instance is not always advisable, because of the impediment offered to the burnishing by such additional stiffness.

When this has been accurately trimmed and fitted at the cervical edge, a cut in each *approximal* side of the band, beginning at the incisal and extending well toward the cervical edge, will facilitate the subsequent burnishing of the platinum into a close conformation with the root. A blunt piece of wood and a light mallet, or a smooth foot-plugger in an automatic mallet may be found useful in this procedure, but care should be exercised to avoid drawing the cap down from its proper cervical relation.

The edges should now be pinched together with pliers around the incisal end of the root until in close contact, the cap then removed, the surplus trimmed away, and the joints soldered. Pure gold will answer

nicely for this purpose, if used *sparingly* and properly fused, though platinum solder is preferable.

Platinum foil, No. 60 or 120, may often be used in securing the proper adaptation around the cervix, and slightly beneath the free margin of the gum, to which point it should be carried, because of the greater facility with which it may be even more closely adapted; and extreme thinness of the cap, on the labial surface, at least, is also advantageous to the subsequent adjustment of the facing. In the use of the foil, however, when the proper adaptation has been secured by burnishing, with the surplus overlapped upon the approximal and lingual surfaces, the cap should then be slightly re-inforced with platinum solder, or pure gold thoroughly fused.

The best results are doubtless to be obtained, as a general practice, from the use of the heavier cap, and while *pure platinum is not as soft and malleable as pure gold,* if the piece is well annealed in the porcelain furnace, as recommended, no great difficulty will be experienced in adapting platinum of 36 gauge to the requirements of these cases. If preferable, the adaptation may be secured by taking an impression of the end of the root, making dies and swaging, as previously described.

The entire surface of the cap, however made (Fig. 192, B), should now be slightly roughened with a sharp chisel, or other convenient instrument, to facilitate the attachment of the porcelain, and the impression taken with it in position on the root. Before filling the impression, the cap should be filled with wax to facilitate its subsequent removal from the model.

A very *thin* facing (Fig. 192, C) of the proper size and color should now be selected and ground to its proper adjustment. This sometimes requires that the entire lingual surface, including pins, be ground away until only a very thin *veneer* remains, but it is best to allow the pins to remain also, if possible, because of the advantage to be derived from their presence in securely sustaining the relation of the facing to the cap, by bringing them in contact and soldering, previous to applying the porcelain. (Fig. 192, D.)

Where it becomes necessary to grind the pins away entirely, the difficulty of sustaining the *veneer* in its relation to the cap during the application and fusing of the "body" is, of course, increased, and extreme care is necessary in heating the case, because of the possible expansion incident to too rapid heating; and in fusing, because of the shrinkage, each of which may result in a displacement.

This procedure may be facilitated by first covering the cap with a thin layer of "body" and fusing it until the particles are well coalesced, without presenting a glazed surface. This then admits of a more ready

and secure attachment of the veneer to the cap by holding it in place and packing thinly mixed body into the space between it and the cap, until it is retained in position by the adhesive properties of the body after the moisture has been evaporated, when it is ready for the final attachment to be obtained by the fusion of the porcelain. Fig. 192, E, illustrates the finished crown.

**Variation of Method.** A method of veneering platinum and gold crowns constructed in the ordinary manner, excepting that the dimensions are reduced enough to admit of the presence of a covering of porcelain, which is retained in contact with the metal by roughening the surface, is recommended by Dr. George Evans and others, as a means of securing the presentation of a more esthetic effect, combined with the advantages of a metal crown.

As *thin* layers of porcelain, whether of the high or low fusing variety, *do not possess strength,* and as *there is no physical or molecular union between porcelain and platinum, or gold,* the method is not considered to be a safe or reliable one.

Where the jacket crown is to be employed in combination with porcelain, the strength of the body itself, and the integrity of the attachment between it and the metal parts, both of which are essential to the durability of the finished crown, will increase in proportion to the diminution of the root, the quantity of porcelain thus accommodated, and the degree of *mechanical* attachment for it, which is to be obtained by roughening and serrating all surfaces of the metal which are to be covered with the "body."

On the other hand, it must, of course, be remembered that the degree of integrity in the attachment of the finished crown to the root will increase in proportion to the extent of tooth structure which is allowed to remain and which may be telescoped by the cap.

## Use of the Davis and Logan Crowns.

Ready-made porcelain crowns, such as the Davis and Logan designs, may sometimes be employed to good advantage in porcelain work for the six anterior teeth, by combining them with a a platinum *plate* or *cap,* as a means of securing accuracy in their adaptation and permanency in their attachment to the root.

**Advantages.** The advantages to be obtained in the use of these crowns in this work lie in their artistic form, their unexcelled strength, and the greater degree of translucency which the finished crown will possess, as a result of the absence

of an additional layer of either metal or porcelain placed on the back of the original crown.

While their artistic shape is not to be disputed, the experienced porcelain worker, with a knowledge of tooth-form, will have no difficulty in building the body to an equally artistic outline, where a *facing* is used, so this feature is to be seriously regarded as a consideration only as a means of doing without the knowledge, and avoiding the small amount of time and work thus involved.

The inherent strength of the porcelain of which these crowns are made, which is obtained from the high fusing character of the "body," and from its then being properly *packed* and *fused,* is doubtless greater than the strength of the porcelain part of a crown constructed with a facing. Hence, this feature must be regarded in the light of an advantage of importance, and yet, where a simple facing is used, sufficient strength may ordinarily be obtained by *securely* attaching it to the cap, using a high-grade "body," and properly packing and fusing it.

The greater degree of translucency is indisputably true, and constitutes an advantage of inestimable value in many cases, particularly where the color is extremely difficult to match. While the texture of an ordinary facing may be practically the same as that of these crowns, and it may primarily possess the same degree of translucency, yet this important feature *is,* nevertheless, destroyed to some extent even by the presence of a backing of porcelain, of nearly, if not quite, the same color. This is due to the dividing line between, and the difference in the density of, the two bodies.

These features of *strength* and *translucency* are so important as to indicate the practicability and warrant the use of these crowns in many cases, perhaps, in preference to any other style of construction, where a good selection may be obtained.

**Disadvantages.**

The principal disadvantages lie in the fact that one is confined to a more or less limited selection, and that the opportunities are greater for securing a better choice of facings than of crowns because of the latter being limited to a few dozen moulds, as compared with the several hundred in which the facings are made; also the more intricate procedure, and greater length of time consumed, in grinding the crown to a proper adjustment and relation as compared with the facing.

**Application of the Davis Crown.**

Because of the greater facility with which a crown with a separate dowel may be adapted to the root, the Davis crown will be found more generally useful and applicable in this style of construction.

The accompanying dowel, however, is useless, and must be replaced

with one of iridio-platinum, because the so-called German silver alloys will scarcely withstand the degree of heat necessary to subsequently fuse the porcelain, and the latter will not become attached, or even fuse down close, to these alloys.

**With Band.** In the application of this style of crown with a band, the root should be prepared, the cap made, the dowel attached, and the impression taken, in exact accordance with the requirements indicated for the "band and dowel" style of construction with porcelain, at the beginning of this chapter.

When the model has been secured, the cap should be detached therefrom, then replaced, and the crown selected.

The surplus end of the dowel should now be cut away until only so much remains as will be accommodated by the depth of the countersunk cavity in the crown, and the latter should be ground to the proper and required adaptation with the cap and the adjacent and occluding teeth.

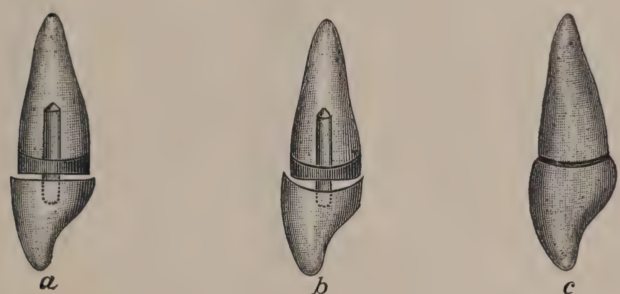



*Fig. 193.*

In this procedure the approximal sides should be ground so as to admit of the overlapping of the labial and lingual edge of the crown upon the cap. (Fig. 193, A.) This is essential for the purpose of bringing the edges of the crown into close proximity with the gum and of retaining the porcelain which is to be subsequently applied to cover the band.

Owing to the shrinkage of porcelain, it is impossible to get enough body between the crown and cap in the first or *primary* "bake" to completely fill the space. This would result in an element of weakness, of course, in the finished crown, and may be overcome by further grinding away the approximal surfaces of the crown, so as to afford opportunity for the admission of a second application of "body," which may fill all crevices caused by the shrinkage of the first. (Fig. 193, B.)

When the grinding of the crown has thus been completed, it should be attached to the cap by filling the countersunk cavity in its body with

thin, well mixed porcelain, and then gently forcing it to place while on the model. The latter should now be gently tapped with an instrument several times to *pack* the porcelain *densely* around the dowel, and in the space, and it should then be allowed to dry until all of the moisture is thoroughly evaporated.

The crown should now be gently removed from the model, adjusted to a proper support, and given the *primary* "bake," and subsequently the *final* one, in accordance with the requirements which will be considered later. The completed crown is illustrated in Fig. 193, C.

**Without Band.**

When it is desirable to construct the crown by this method *without a band,* the foregoing detail is *identical with the requirements,* after the "plate and dowel" have been properly adapted to the root and the impression taken

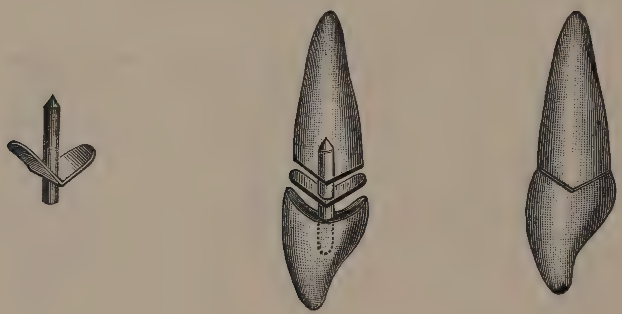


*Fig. 194.*

and model secured, which procedure has been previously considered in its special application to porcelain work in this chapter. The various steps in this style of construction are illustrated in Fig. 194.

**Application of the Logan Crown.**

The Logan crown may be used in similar manner, with either a band or simple plate, and the difference in the procedure incident to its employment lies in the absence of any necessity for using other than the original dowel, which is of platinum and which constitutes an inseparable part of the crown.

The presence of an inseparable dowel in this connection, however, adds somewhat to the detail involved in grinding the crown to the required adaptation with the cap or plate, and necessitates subjecting the porcelain

to the heat of soldering in attaching it thereto, which, of course, is not true in the use of the Davis crown.

**Procedure.**

In the application of this crown in combination with porcelain and a platinum cap or plate, the same detail as indicated in connection with the use of gold should be observed.

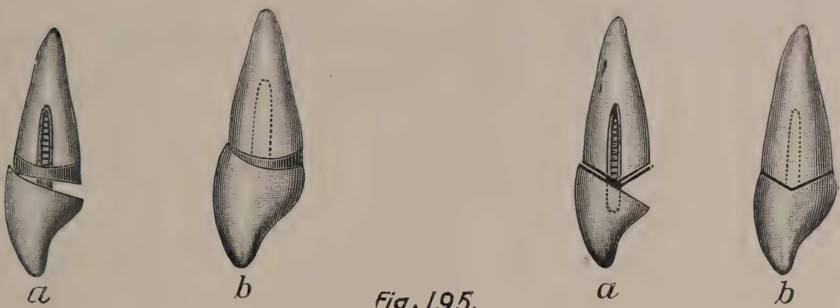



Fig. 195.

The base should be constructed of platinum of the same gauge as for the Davis crown, and the temporary dowel should be adjusted, the impression taken, and the model secured in accordance with the detail previously outlined in the consideration of this style of crown in combination with gold.

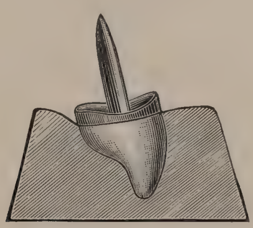


Fig. 196.

The crown should be then selected, ground as thus indicated (Fig. 195, A), attached to the base with a minute quantity of adhesive wax, removed from the model, invested, and the relation between the base and dowel permanently sustained with a small quantity of pure gold, to preclude any possible change which might result from the shrinkage of porcelain.

The soldering may be done with greater facility by covering the entire crown with investment material, leaving only the surface of the base, which comes in contact with the root and the dowel, exposed. (Fig. 196.) Considerable care must be exercised in this procedure, however, to prevent fracturing the porcelain, which can only be avoided by *thoroughly heating* the latter before attempting to solder. This space between base and crown may then be filled with porcelain "body" and fused, and the finished crown is illustrated in Fig. 195, B.

# Composition, Characteristics and Manipulation of Porcelain Bodies.

CHAPTER XIII.

Porcelain Compounds: Composition; Silica, Feldspar, Kaolin, "Flux," Coloring Matter. "High and Low" Fusing "Bodies": Comparative Advantages. Shrinkage, Fusing Points. "Gum Enamel" "Bodies." Requirements for Crown and Bridgework. Manipulation of Body: Preparation of Crown, Selection of Color, Mixing "Body," Applying and Building. One Grade of "Body." Variations in Shading; Use of Oil Colors; Contouring and Carving. Primary "Bake." Final "Bake." "Foundation" and "Enamel" "Bodies." Precautions Incident to Fusing. Supporting Crown in Furnace. Placing Crown in Furnace. Heating Furnace. Fusing: Tests, Porosity. Furnaces: Electric Furnaces, Gasoline Furnaces, Gas Furnaces.

## Porcelain Compounds.

With the rapid development of this class of work, a demand has been created for the production of porcelain compounds which possess qualities better suited to the requirements of *manipulation* and *color* than was characteristic of those which were formerly used, and which had been especially prepared for continuous gum work.

This latter grade of material, as originally compounded by Dr. John Allen, and later by Dr. S. L. Close, in the absence of anything better, was quite commonly used, and, when more finely pulverized to admit of being carved and fused with greater accuracy, it served the purpose so well as to be, to a great extent, responsible for the growth and development of this class of work to the degree of its present successful attainment.

As it was prepared in only one grade and color, however, the de-

mands created by the possibilities of this work soon induced other manufacturers to so alter and improve upon these materials as to furnish compounds which would be somewhat less refractory, and which would more nearly meet the requirements, with the result that several products are now prepared in different grades and varying colors.

**Composition.** These various compounds are supplied in powder form, and are known as "bodies," "enamels," and "gum enamels." They are composed of silica, feldspar, kaolin and a suitable "flux," and are colored, or tinted, with metals or metallic oxides.

**Silica.** Silica is the dioxide of silicon, a very refractory and practically infusible substance found in the form of agate and flint. It is the base of all true porcelain "bodies," and imparts *structural strength* to them.

**Feldspar.** Feldspar is a double silicate of aluminum and potassium. This material is somewhat less refractory than silica, and is incorporated for the purpose of imparting stability to, and increasing the translucency of, the compound.

**Kaolin.** Kaolin is the hydrated silicate of aluminum. This is a very fine grade of clay, and is a most essential ingredient, being incorporated for the purpose of imparting stability of form by holding the particles together, and thus facilitating the moulding and carving of the mass into the desired shape.

**"Flux."** The "flux" is usually composed of the carbonates of the alkaline metals, sodium and potassium, though in some classes of compounds the oxide of lead is also much used.

The quantity and nature of the "flux," and the manner of its incorporation determines the fusibility of the former refractory ingredients, and the tensile strength, or resistance to fracture, of the mass when all are fused together.

**Coloring Matter.** The coloring matter employed for the purpose of imparting the required variations of shade must necessarily be more or less *high fusing* in character, in order that the color, or tint, may not be dissipated, or burned out, in the fusion of the compound.

While the coloring matter itself has practically no influence upon the fusibility of the compound, the color imparted is, however, materially affected by the degree of heat required. For this reason, metals, or metallic oxides, are used for this purpose, in which the basal shades imparted are, approximately, as follows:

| | |
|---|---|
| Yellow, | Titanium. |
| Brown, | Iron. |
| Blue, | Cobalt. |
| Gray, | Platinum. |
| Pink (gum enamel), | Silver and tin in combination with gold (purple of cassius). |

The colors and tints characteristic of the different "bodies" are produced by the use of these in various compounds, of equally varying proportions, but the exact formula and methods of procedure are of special interest to the manufacturers only, and are usually more or less carefully guarded by them.

## "High" and "Low" Fusing "Bodies."

The several varieties of "body" now prepared may be classified into two distinct grades—the so-called "high" and "low" fusing, with the line of common distinction between them being based, approximately, upon the fusing point of pure gold.

**Comparative Advantages.**

An intelligent analysis of the comparative qualities and advantages of the two classes of "body" demands a more or less limited familiarity with the composition of these compounds, and with the characteristics of their respective ingredients.

Silica being the most refractory and infusible substance, it might be commonly supposed that a "body" capable of being fused at a lower temperature than another would necessarily contain less of this ingredient and more feldspar and kaolin in proportion.

Such an assumption would be correct if the "flux" played a less conspicuous part in the reduction, but the same relative formula of the three basal ingredients may be used, and yet the fusing point of the resulting compound be regulated by the proportion of "flux" subsequently added to this formula.

But as a "body" must possess sufficient inherent strength, integrity and stability to offer a high degree of resistance to fracture, and must possess translucency, and absence of opaqueness, an *adequate* proportion of these three basal ingredients seems essentially necessary, since each has its place and purposes in the compound, as previously indicated.

This being apparent, if the fusing point is then regulated or controlled by the proportion of "flux," and it is conceded that the latter does not impart to the compound the highest degree of strength possible, in the light of our present knowledge it seems reasonable to deduce that, when a sufficient proportion of "flux" to reduce the fusing point of these refractory materials below a certain point is incorporated, the maximum degree of strength possible is not imparted to, nor obtained in, the product.

It, therefore, seems evident that when a maximum degree of strength is to be obtained, such as is required in the construction of crowns, or bridges, where at best the friable material is to assume the full stress of mastication, by direct contact, the compound which will best serve the purpose must be one possessing the integrity and stability imparted by the three basal ingredients to a degree not entirely destroyed by the incorporation of too great a proportion of "flux."

**Shrinkage.** All porcelain compounds *shrink* in fusing in proportion to the degree of their fineness of texture, and the quantity and nature of the "flux" used; and the degree of shrinkage adds to the difficulties incident to their manipulation with certainty, accuracy and expediency.

The "high" fusing compounds shrink from ten to fifteen per cent, while the "low" fusing range from the latter point up to 25 per cent, and some of the *glass* or extremely low fusing "bodies" which contain lead in large proportions even greatly exceed this. There is never any indication for the use of the latter, however, because of their minimum strength, and of their invariable tendency to discolor in the mouth, which may be attributed to the presence of the lead.

All of the compounds are more or less porous, and hence translucent, in proportion to the degree of fineness to which they are pulverized before fusing. Hence, as the lower fusing "bodies" are always reduced to a much finer texture in their preparation, they possess a greater density of structure.

This increased density, however, is due to the more homogeneous coalescence of the particles as a result of the more thorough admixture of the "flux," and is gained at the expense of translucency and stability, since the "flux," beyond a certain proportion, does not add integrity to the mass, but, on the contrary, increases the shrinkage, friability and tendency to globulate in fusing.

The degree of shrinkage is a very objectionable feature in this work, where so large a quantity of body is used, because the resistance to the *contraction* which takes place in the lower fusing "bodies," and which resistance is offered by contact with facing and cap, induces a tendency to fracture which greatly diminishes the strength.

A summary of the apparent disadvantages to be found in the "low" fusing "bodies" thus consists in their degree of *contraction*; their *diminished strength and translucency,* and their *lack of stability of form and color.*

These features also make their manipulation with accuracy and certainty more difficult, particularly for the inexperienced, because of the necessity for shutting off the heat at the precise degree at which the

proper fusing point is reached, in order to avoid a dissipation of the color, and a loss of the desired form, as a result of their great tendency to become spherical immediately following the definite and exact point of fusion.

For these various reasons, the use of the "low" fusing, or so-called "enamel bodies," or those which contain a large enough proportion of "flux" to reduce their fusing point below that of pure gold, and to decrease the stability of form and color, which are imparted largely by the three basal ingredients, cannot be considered at the present time, as being conservatively reliable for this special class of work.

Furthermore, a series of comparative tests for crushing and tensile strength of most of the various "bodies" now prepared, as conducted by Dr. J. E. Nyman, seems to prove conclusively that the most useful and reliable compounds for this class of work are to be found among those which fuse between 2,100° and 2,500° Fahrenheit, with the pyrometer gauged by the fusing point of pure gold, as being 2,016°.

**Fusing Points.** The following table gives the approximate fusing points of most of the various bodies now in common use, as well as of the different makes of teeth, as compiled by Mr. J. F. Hammond, and Dr. W. A. Capon, in the Hammond Electric Furnace:

| "Body." | Current. | Rheostat. | Time. | Tem. Fahr. |
|---|---|---|---|---|
| Jenkins's ................ | 110 volts. | 1st step. | 2 min. | 1,544 |
| Ash's Low Fusing........ | 110 " | 1st " | 2 " | 1,544 |
| Ash's High Fusing........ | 110 " | 4th " | 2 " | 1,904 |
| Moffitt's Porcelain......... | 120 " | 2d " | 2 " | 2,047 |
| Brewster's Enamel........ | 110 " | 4th " | 2 " | 2,084 |
| Consolidated's High Fusing. | 110 " | 5th " | 2 " | 2,192 |
| Whiteley's Porcelain....... | 110 " | 5th " | 2 " | 2,210 |
| Brewster's Found Body.... | 110 " | 5th " | 2 " | 2,300 |
| Close's Found Body........ | 110 " | 5th " | 2 " | 2,300 |
| White's Porcelain.......... | 110 " | 5th " | 2 " | 2,300 |
| Parker's Body............. | 120 " | 5th " | 2 " | 2,586 |
| Ash and Sons' Tooth Body. | 110 " | 4th " | 2 " | 2,264 |
| Sibley's Tooth Body....... | 110 " | 4th " | 2 " | 2,408 |
| Dental Protective's Tooth Body .................. | 110 " | 5th " | 2 " | 2,440 |
| Justi's Tooth Body........ | 110 volts. | 5th step. | 2 min. | 2,440 |
| S. S. White's Tooth Body. | 110 " | 6th " | 2 " | 2,516 |
| Johnson and Lund's Tooth Body .................. | 120 " | 5th " | 2 " | 2,586 |
| Luken's Tooth Body....... | 120 " | 5th " | 2 " | 2,606 |
| Century Tooth Body....... | 120 " | 5th " | 2 " | 2,624 |
| Consolidated Mfg. Co.'s Tooth Body .................. | 120 " | 5th " | 2 " | 2,624 |

## "Gum Enamel" "Bodies."

The compounds designated as "gum enamel" bodies contain a larger proportion of "flux" than basal bodies, and consequently fuse at a lower degree of heat, and possess less strength. Hence, when their use is indicated for the purpose of producing an artificial restoration of the gum color, the major portion of the contour of the piece should be made of the basal "body," and the "gum enamel" subsequently applied where necessary, and only for the purpose of imparting the gum color.

Previous to the application of the "gum enamel," the basal "body" to be covered by it should be fused until it presents a fairly smooth and well-vitrified surface. This is necessary, because it is not to be re-fused, and the maximum degree of strength will not obtain until its particles are well coalesced, and all shrinkage has taken place, and if this is accomplished at the time of the fusion of the "gum enamel," the color of the latter will likely be burned out or dissipated, owing to its greater fusibility, and its surface will present innumerable fractures, as a result of the further shrinkage of the base.

A new form of "gum enamel" has been introduced by Mr. Robert Brewster, of Chicago. This consists of a finely pulverized "body," which is mixed to the desired consistency with *oil,* and then painted upon the surface and fused, in the manner previously indicated, in connection with the use of "oil colors."

It would seem that this should prove to be the ideal method, because the same effect, and greater variations in shading, may be obtained, without diminishing the strength or increasing the weight or bulk of the finished piece.

## Requirements for Crown and Bridgework.

A class of "body" possessing qualities adaptable to the maximum requirements for crown and bridgework will thus doubtless belong to the high fusing variety, and should be prepared in *one grade;* of a sufficient variety of colors, and pulverized *only* to a degree of fineness which will admit of being nicely carved. This latter feature is essential, because the shrinkage is increased and the fusing point decreased in any given compound in proportion to the degree of fineness in which it is prepared.

Those which are to be especially recommended are Brewster's *"Crown and Bridge;"* "S. S. White's;" the Consolidated Dental Mfg. Co.'s and Whiteley's products, all of which are supplied in neat and compact form, in a good variety of colors, quite adequate to the requirements for this work. While good results may also be obtained from the use of Brewster's "Inlay Bodies," which consist of *two* grades—"foun-

dation" and "enamel"—the best possible results are doubtless facilitated and afforded by the employment of *one grade* of material throughout the construction of the piece, and no difficulty will be encountered in obtaining the deisred *enamel surface* in any of these compounds, if they are fused to the proper degree of vitrification, without the use of any of the lower fusing, or so-called "*enamel bodies*" in conjunction therewith.

## Manipulation of "Body."

That portion of the procedure which involves the manipulation of the "body" requires the most consummate judgment and skill, and, while it is largely true that the *strength* of the finished piece is much dependent upon the *metal construction* which forms the *foundation* for the porcelain, the degree of possible strength may be still further increased by skilful manipulation of the latter, or, as the converse is equally true, it may be diminished accordingly.

**Preparation of Crown.** When the crown has been taken from the investment, after soldering, it should *first be thoroughly cleaned* in 50 per cent sulphuric acid, in order to insure the removal of all remaining traces of borax or investment material which may cling to it, and which would be apt to interfere with the subsequent fusion of the porcelain; and the presence of borax is particularly objectionable, because it acts as a "flux."

The *surplus* ends of the *dowel* and *pins* should be ground down *smooth*, and so that they offer no obstruction to the contour, and afford no weakening of the porcelain, by extending or projecting into it, thus dividing it through the center, and all *sharp angles* should be nicely *rounded*.

These requirements are imperative, as the "body" should occupy all of the space possible. It will not fuse down close nor become attached to unclean or irregular surfaces, and in fusing will usually either draw away from, or fracture over, sharp angles as a result of the shrinkage.

When these precautions have been observed, the crown should be again treated to the acid bath, and then washed freely with clean water; if a *carborundum* stone has been used, care should be exercised to remove all particles which may cling to, or remain upon, the metal, or facing, as the presence of such particles will invariably cause a *discoloration* of the porcelain.

A close observation of these prerequisites, combined with *scrupulous care* and *extreme cleanliness* throughout the subsequent procedure, will materially increase the chances of securing successful results.

These results will also be greatly facilitated by confining the work

to a place especially prepared for such purposes, or to a portion of the work-bench which has been previously cleaned and arranged; all of the necessary instruments and appurtenances to be used should likewise be kept perfectly clean.

**Selection of Color.** When a suitable place to work is thus prepared, and the crown is ready for the application of the "body," its dowel should be grasped firmly between the jaws of a slide pin-vise, which will hold it securely during the building and carving (Fig. 197), and the proper color of "body" then selected.

This should approach the shade of the facing when one is used, or else of the color desired, as closely as possible, and may be accomplished with the use of the shade-guide, which accompanies the various makes of porcelain.

If the exact color cannot be matched, and some variation becomes necessary, a shade *slightly darker* than the facing should be selected, owing to the tendency to *bleach* somewhat in fusing. In this connection, it must be remembered that the *true color* of the porcelain compound will be obtained *only* when it is fused to the *exact* point of complete vitrification, and that it will become lighter in shade as it is carried beyond, or above, this point.

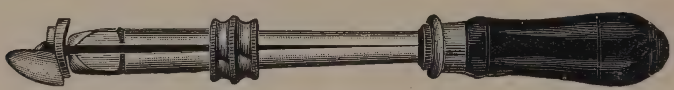


*Fig. 197.*

**Mixing "Body."** An adequate quantity of the "body," which corresponds in color to that selected on the *shade-guide,* should now be placed upon a clean porcelain or glass mixing slab, *distilled water* added, and then mixed thoroughly with a suitable spatula, until it assumes the consistency of thick cream. The water may be added in the most convenient and expeditious manner, by means of the "dropper," or "pipette bottle," such as is contained in many outfits for this work and which also serve to keep it pure and clean for subsequent use.

Sufficient water to insure the *desired consistency* and *thorough mixing* are quite essential, and any surplus of "body" is not wasted, because it may be replaced in its proper receptacle and used at another time.

Alcohol is sometimes recommended and used because of expediting the evaporation of the moisture from the compound, and thus facilitating

the carving of the mass, but this feature, because of usually being too rapid, is more often an objection than an advantage.

The addition of a small proportion of gum tragacanth to the water is also recommended as furnishing a means of adding to the cohesion of the mass after the evaporation of the moisture, and thus facilitating the carving and contouring, but its presence is objectionable, because it seemingly acts as a "flux" in the fusion of the porcelain, and is unnecessary, because the manufacturers usually incorporate a small proportion of starch in the compound for this special purpose.

The use of pure clean water is preferable. It should be *distilled*, however, because the presence of lime or organic matter may have an injurious effect upon the fusion of the porcelain.

## Applying and Building.

In the manipulation of these compounds, it must be remembered that their tendency to *shrink* in fusing plays quite an important part, and governs the method of procedure to a large extent.

**"One Grade" of "Body."**

In the use of one grade of body, *having the same fusing point*, throughout the construction of the piece, the desired shape and contour for the finished crown should obtain for the first, or *primary*

*Fig. 198.*

"bake," and yet it is *seldom possible* and *never expedient* to complete it in *one "bake,"* because of the shrinkage.

This latter feature necessitates *two*, and sometimes even more, "bakes," though the procedure is somewhat facilitated by forming the desired contour, even to the requirements of occlusion for the *primary* "bake," and the second or *final* application of "body" should then be made for the express purpose of *restoring that portion of the original form which has been somewhat changed by the shrinkage incident to the primary fusion* or "bake."

With the crown grasped firmly in the pin-vise (Fig. 197), and the body mixed to the proper consistency, a small quantity should be picked up with the point of a suitable instrument and first forced into the joint between cap and facing.

This may be facilitated by gently tapping the handle of the pin-vise, or by drawing a coarsely serrated instrument across it, and the procedure should be continued until the "body" is *thoroughly packed* into the space.

A suitable instrument, designed by the author, for universal use in this work, and combining a spatula for mixing, a serrated shank for packing, and a pointed blade for carving, is illustrated in Fig. 198.

This feature of *packing* is imperative throughout the entire building up of the crown, as a means of insuring a high degree of integrity in the mass when fused, and of overcoming the tendency toward *porosity* in fusing, by insuring a close and *compact coalescence* of the particles.

As the building up progresses and each additional application of body is thus carried to place, and the contour formed, the procedure may be facilitated by absorbing the excess moisture, as it is brought to the surface, with a clean piece of linen or cotton cloth, or blotting or bibulous paper, until the approximate outline for the finished crown, *with a slight surplus,* obtains.

The latter part of the procedure may be accomplished with greater ease and facility by mixing the body to a *thicker consistency* after the joints and all small interstices are well filled.

When the required form has been obtained, the remaining moisture may be then more quickly evaporated by *passing the crown over a flame* until the mass is sufficiently dry to admit of being nicely carved.

The "body" should always remain moist enough, however, to be carved and trimmed without flaking or crumbling, and in the event of its becoming too dry to admit of this, it may be again slightly moistened by touching it with a wet brush.

In building up bicuspids and molars, after first filling the joint, a narrow strip of blotting paper may be conformed to the outline of the lingual portion of the band, and when held in place will serve as a matrix to hold the body in shape which thus facilitates the procedure.

**Variations in Shading.**

Variations of shade may be quite easily obtained by selecting the appropriate colors of body and mixing them separately. The color indicated for the base of the crown should then be applied, and built up to the desired point, when the other may be added without allowing the first to become completely dry.

Their use in this manner affords opportunity for blending them in fusing, and very artistic results are possible, particularly in those cases where the base should be yellow, or brown, and the incisal or occlusal end blue, or gray, in any of their variations.

**Use of Oil Colors.**

The use of the oil colors previously mentioned may also be productive of most excellent and artistic results. They should be *thoroughly mixed* to a thin consistency, with the accompanying *oil,* applied with a small brush, and separately fused.

Where it is desirable to produce a change in the color of the *facing,* these colors should be applied at the desired point on the *lingual surface,* and then fused, after which the "body" may be applied, as required, and the underlying color will show through the more or less transparent facing.

An appreciable change in the color of the porcelain forming the body of the crown may also be produced by applying and fusing these colors to the surface after the *primary* bake, when the final contouring may be made, the transparency of which, after fusion, will indicate the presence of the underlying color.

In simulating the characteristics of remaining natural teeth, *grooves, pits and sulci* may be colored or tinted as desired. As these colors fuse lower than the "body," however, this work can be done to the best advantage *after the crown has been otherwise completed;* and when they are used for such purposes on the labial or buccal surfaces of the facings, the desired inequalities should first be ground with a small carborundum stone in the engine, and this outline then properly colored or tinted, and the crown again fused until the colors become vitreous.

**Contouring and Carving.**

If not too dry, the procedure incident to contouring and carving the "body" is quite simple, but the artistic results will depend much upon personal equation and knowledge of the forms of teeth.

This may be easily acquired by a close study of natural teeth, and a good plaster model of a full typical arch will assist by serving as a guide in the execution of this work.

As has been previously stated, anatomically correct outlines are not essentially necessary, and artistic results may be obtained by simply so typifying the cusps as to distinguish between the right and the left, the upper and the lower teeth.

The requirements of occlusion with the opposing, and contact with the adjacent, teeth may be observed by trying the crown upon the model during the process of carving, and in order to prevent flaking the body or changing its given form, it may be carefully and *slightly* moistened with a wet brush previous to such trials.

For this reason, it is always necessary to have a good model to which the crown may be easily adjusted to position, as has been previously recommended.

In contouring and trimming the porcelain, it *must not overlap the band,* upon any surface, nor at any point, excepting along the *labial* or *buccal* surface, *where the facing mechanically retains it,* for without such means of retention it will invariably fracture or break away, leaving a rough, sharp, or irregular joint with the cap; and previous to placing

the crown in the furnace all particles of body which remain deposited upon, or overlapping, the surface of the facing, or which may have found lodgment on the inside of the cap, or on the under surface of the base, should be carefully removed with a clean, dry brush to prevent it from becoming attached in fusing.

The brushes used in this work should be of a good quality, such as are employed in water color painting, and the three useful sizes and shapes are illustrated in Fig. 199. The largest size should always be kept dry and used only for smoothing up the work, while the medium

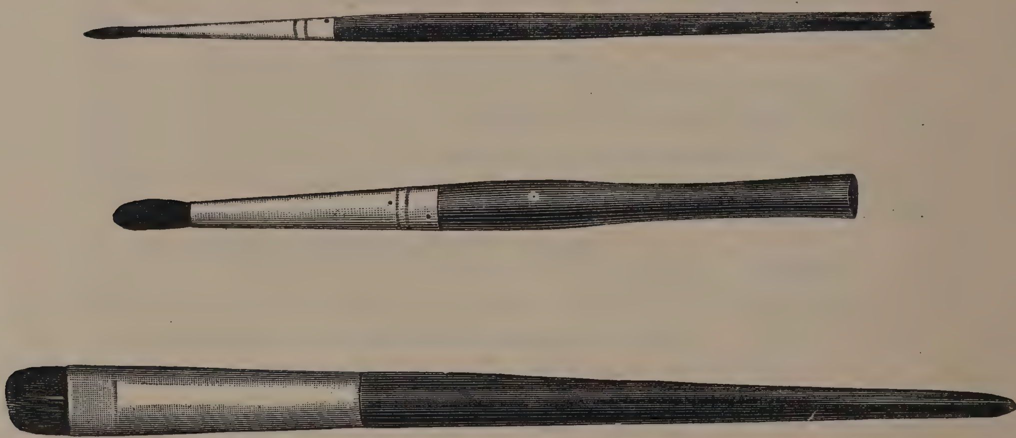


Fig. 199.

Fig. 200.

size should be employed for the purpose of moistening the "body," when necessary, and the smaller one only for painting, or deepening the finer lines in carving.

A very convenient form of simple carving instrument, designed by Mr. Robert Brewster, is illustrated in Fig. 200.

In trimming the body, the allowance of a slight surplus is demanded by the shrinkage, but the exact extent may only be ascertained with accuracy by a familiarity with the compound used, as all vary considerably in such properties.

The crown, when the body has been trimmed, and carved, and when ready for the *primary* "bake," is illustrated in Fig. 201 A.

**Primary "Bake."** When this desired form, and blending of color, have been obtained, the crown should be placed in the furnace and "baked" until the body becomes *slightly vitrified,* and the *particles well coalesced,* but its surface *should not be highly glazed* at this time.

This degree of fusion, or vitrification, is preferable to the so-called *biscuit* bake, commonly advocated, because of the desirability of securing a maximum degree of shrinkage in the primary fusion, but the surface should not be allowed to become *smooth* and *vitreous* at this time, because the second application of the body will not adhere so well to it. Fig. 201 B illustrates the appearance of the crown after the "primary bake," and indicates the degree of shrinkage and consequent change of form which takes place.

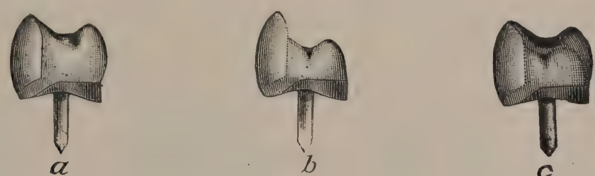


Fig. 201.

**Final "Bake."** For the final "bake," the crown should be again adjusted in the pin-vise and the "body" thoroughly mixed, *to a thin consistency, and first worked well down into every crevice and fissure* caused by the shrinkage, and then applied over the surface until the desired contour has been obtained, when it should be fused to the required degree of vitrification for the finished work, which is illustrated in Fig. 201 C.

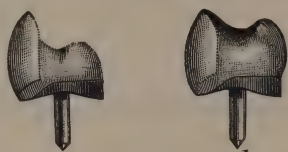
If the crown comes out of the furnace after this "bake" presenting an irregular or broken surface of porcelain, such places should be filled with "body," and again fused, though if the proper precautions are observed, this will seldom be necessary.

**"Foundation" and "Enamel" Bodies.** When two grades of "body" which fuse at different temperatures, such as the so-called "foundation" and "enamel bodies," are used, the requirements are somewhat different from those indicated for one grade of body, because, if the desired contour of the crown is obtained in the primary formation and fusion, it will be difficult to manipulate the "enamel" body for the final bake, as it will necessarily need to be applied so thinly over the surface of the "foundation" body as to preclude any

carving, and increase the tendency to flake off, or become detached in places, before fusing.

Hence, where it is desirable to use two grades, the higher fusing, or "foundation," body should be applied first, only in quantity sufficient to indicate the desired form, as illustrated in Fig. 202 A.

This should be fused and the lower fusing, or "enamel," body then applied, trimmed and carved as desired (Fig. 202 B), and then fused.



a b

*Fig. 202.*

The increased quantity of the latter body and its greater shrinkage demands an allowance of more surplus than would be necessary if the same higher fusing body were used throughout.

## Precautions Incident to Fusing.

No portion of this work is of more importance than the "baking" or fusing of the body, because the *strength* of the porcelain, and its true color, no matter to which class it belongs, are entirely dependent upon its being properly fused.

*Fig. 203.*

**Supporting Crown in Furnace.**

When the crown is ready for the furnace, it must be adjusted to a suitable form, which will *accommodate the dowel, support the base of the crown* by allowing it to *rest firmly and evenly,* and which will sustain it in a perpendicular position while in the furnace.

Whilst platinum trays were first used, and are even now occasionally recommended, for this purpose, their employment is objectionable because crowns not infrequently become attached to them in fusing, and

in the subsequent detachment the porcelain may be checked, or the shape of the band altered.

This attachment may be due to the re-fusion and flowing of a surplus of the pure gold, when such is used in soldering, or to an excess, or the over-fusing, of the porcelain, but whatever the cause, may be precluded by the use of supports made of *fire-clay* or chalk, of suitable form.

The proper adjustment of a crown with and without a band, to the style of support indicated for each, is illustrated in Fig. 203.

Such supports may be made by moulding a good grade of fire-clay to the desired shape, and "baking" it; or may be procured in various designs to meet the equally varying requirements of practically indestructible material from many of the manufacturers of furnaces and "bodies."

Useful designs for this purpose are supplied by Dr. R. C. Brophy, of Chicago (Fig. 204), or may be made by trimming down a piece of ordinary blackboard chalk to meet the requirements of the case.

*Fig. 204.*

The latter is composed of compounds of magnesium and calcium, which are practically infusible, and being very inexpensive, it is quite useful. Such supports will serve the purpose nicely for individual fusings and may even be used two or three times before the form is lost.

**Placing Crown in Furnace.**

In placing the crown in the furnace, it should be observed that the dowel does not extend entirely through the perforation for its accommodation in the support, so as to bring its end in contact with the floor of the muffle; and that the facing does not touch the dome or sides of the latter, as such contact in either instance will invariably result in a fracture of the facing, due to too rapid heating, or uneven expansion.

The crown should be held in a perpendicular position, if possible, in order to prevent any change of form which might be induced by the influence of gravity, when the mass is in the fused state; and the body should always present toward the opening or door of the muffle, so that it may be closely watched while fusing. This latter feature is of

special importance, because if the body is not visible to the eye, portions of it may flake off unnoticed during the heating of the case, and necessitate a subsequent bake, to avoid which it should always be heated carefully and watched closely during the fusing.

**Heating Furnace.** As a matter of expediency, the heating of the furnace should begin immediately preceding, or during, the building up of the crown, so that the muffle will be thoroughly, but not excessively, heated when the crown is ready for the baking.

When these precautions have been observed, the support carrying the crown should be placed near the opening of the heated muffle and allowed to remain for a few moments, in order to become *thoroughly dry* before it is placed inside of the furnace. This will preclude *blistering* the surface of the "body," or the displacement, or flaking, of particles from the crown, as a result of the expansion of the remaining moisture, which would be induced by too rapid heating.

In placing the crown in the furnace, it should be carried to a position as nearly in the center of the muffle as possible, or to that point where there are the greatest number of heat units. For the reason that this heat area varies to a considerable extent, it is seldom advisable in the smaller crown furnaces, with the opening in one end only, to fuse more than one or two crowns at a time, and if each is to be baked *uniformly*, they must be placed *crosswise* in the muffle, in order to get such a result, as the temperature decreases toward the door or opening.

## Fusing.

In the fusing of porcelain "bodies" the physical process involved constitutes changing the powdered *granular* mass into a *vitreous* substance, which is then more or less homogeneous in proportion to the thorough admixture of the "flux," or the degree of complete coalescence of all of the particles.

Hence the proper fusing of these compounds is largely a matter of experience. In the lower fusing "bodies" the proper and desired degree of vitrification may be easily and definitely ascertained by observing this physical change as it is produced by the application of heat. This is also true of the higher fusing bodies, but the greater degree of heat required, and the consequent incandescence within the furnace makes it more difficult. The eye may be trained to a degree of familiarity with the physical changes, however, which will enable the experienced operator to more or less easily distinguish the disappearance of the rough or *granular* surface, and the appearance of the smooth, glassy or *vitreous* surface even in the, at first, somewhat trying glare of the incandescent heat, without

greatly endangering or impairing the sight, because it is not necessary to bring the eyes close enough to the furnace to be seriously affected by the heat.

Smoked or colored glasses may be found useful in this connection, and during the fusing of the "body" the furnace may be occasionally opened for this purpose without danger of fracturing the facing, because the volume of heat is too great to admit of the ingress of cold air.

While everyone desiring to do this class of work in the most accurate and successful manner should cultivate this degree of familiarity with the characteristic appearance of the "body" in the various stages of vitrification, it can only be acquired through experience. When the crown is properly placed in the furnace the heat should be gradually increased until a bright red color is produced. This may be done by degrees without observing the crown itself, but from this point on the latter should be watched closely so as to observe when the rough and granular surface becomes smooth and vitreous, which to the experienced eye is indicated by the degree of incandescence, and as soon as a *glassy* appearance has spread over the entire surface of the porcelain the heat should be immediately turned off.

**Tests.**

Many tests for determining the exact heat required to properly fuse the various "bodies" have been suggested. Alloys of platinum and gold prepared in various proportions with a view to having the test metal melt at the same point as the porcelain would greatly facilitate the fusing, but as this requires a special alloy for each kind of "body," and as these are not on sale ready prepared at the present time, it involves considerable experimentation to apply this method.

**Pure Gold.**

Pure gold may be used with some degree of facility, and its use is recommended as a guide to the beginner and an aid even to the experienced. A pellet of foil, or a globule *previously flattened* on the anvil for each fusing may be placed alongside of the crown in the furnace. When this fuses, which may be noted by its assuming globular form, the beginning of vitrification of nearly all of the higher fusing bodies will be indicated.

From the moment of the fusion of the gold to the required or desired point of vitrification of the porcelain, *time* is the only reliable test other than the eye, and as this varies with each furnace and class of body, it must be previously more or less definitely ascertained by experimentation.

The separate fusing of several cubes of the "body" used will enable one to ascertain the exact time after the fusion of the pure gold with approximate exactness. When the desired point of fusion has been

reached the heat should be immediately shut off, and the crown allowed to cool slowly until a low temperature obtains, when it may be removed from the furnace. Whilst immediate removal as soon as the heat is turned off, and then placing the crown in a *cooling muffle,* or in some convenient receptacle where the air will be excluded until it is cold, is sometimes recommended, and is permissible in emergencies, the furnace itself affords the best "cooling muffle," and the slow and gradual cooling of the piece seems to "*temper*" or anneal the body, and thus render it less brittle.

**Porosity.**

Porosity of the body after fusing is one of the chief causes of failure in this work. When this occurs it may invariably be attributed to one of three causes,—the use of a surplus of pure gold in soldering; imperfectly "*packing*" the body in building up the crown, or *overfusing* it in the furnace.

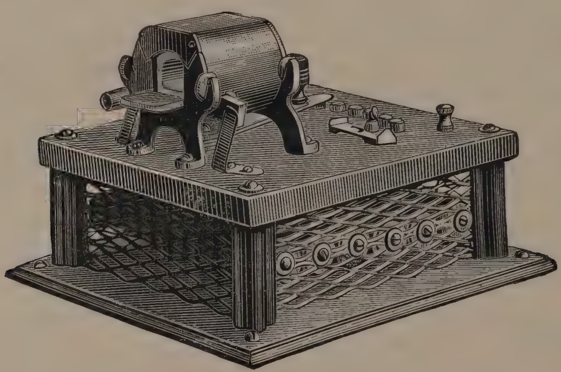


*Fig.205.*

An excess of pure gold which occupies space and which space subsequently becomes a vacuum when the gold is fused in the furnace and absorbed by the platinum, can be avoided by using a minimum quantity of, and properly fusing the gold during the process of soldering.

There is no excuse for imperfect "packing" if the precautions indicated are observed; and "overfusing," which will be denoted by the beginning of a change of form, will not occur if the case is watched closely while in the furnace, or the time test is accurate. This is extremely essential to the success of the finished work, because overfusing burns out, or dissipates, the color, and destroys the integrity of the material, no matter to which class it belongs.

When the final baking has been completed the exposed lingual sur-

face and entire edge of the platinum band should be smoothed with sand-paper and polished with cuttle-fish disks, and the crown then tried to place and mounted.

## Furnaces.

Several varieties of furnaces are now made for porcelain work in which three sources of heat production are successfully employed,—electricity, gasoline and gas.

**Electric Furnaces.** The electric furnaces, or "ovens," in which the heat is obtained by the passing of the current through a close coiling of small platinum wire slightly imbedded in fire-clay without contact, or wound around the out-

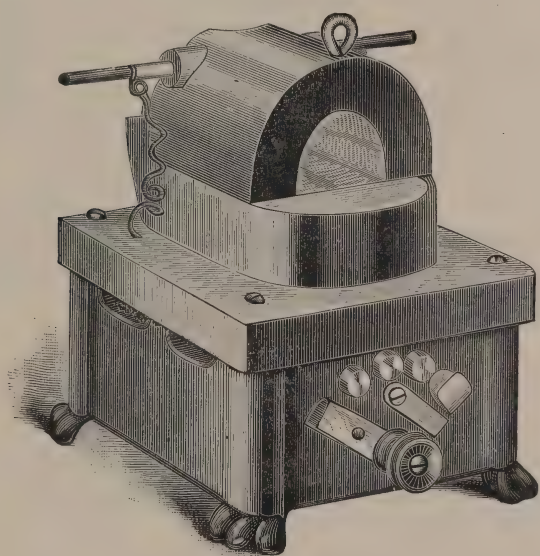


*Fig. 206.*

side of a thin muffle, possess the advantages of purity, range and control of heat, and of cleanliness and the absence of noise or odor.

Owing to the absolute purity of the heat thus obtained any possible danger of discoloring the porcelain from "gassing," is eliminated; and for all of the combined reasons mentioned the use of the electric furnace is recommended wherever it is possible to secure suitable commercial current, such as is supplied for incandescent purposes.

Of the several makes of these furnaces especially constructed for small work, such as single crowns and small bridges, those designed by

Mr. J. F. Hammond, of New York, and Dr. L. E. Custer, of Dayton, Ohio, are to be especially recommended as being neat, compact and serviceable, as are also the "Hewett" and "Pelton" designs.

These furnaces include a rheostat in serial connection with the muffle or "oven" and forming the base of the furnace, and they work equally well on either the direct or alternating currents of the same voltage.

While the two former furnaces are made in three sizes, the Hammond No. 2, Fig. 205, and the Custer No. 5, Fig. 206, will be found to be the most convenient size for this special work, though there is no objection to using the larger sizes which are designed for continuous gum work when several crowns at one time, or large bridges, are to be "baked."

As the larger sizes require more time in fusing, it is more expedient to use the smaller ones for crown work. The *opening* in the latter, however, is in *one end,* hence the heat is greatest as the back wall of the muffle is approached. For this reason, if more than one piece is "baked" at the same time, they must be placed *crosswise* and *not lengthwise* with the muffle, in order that the porcelain may be uniformly fused.

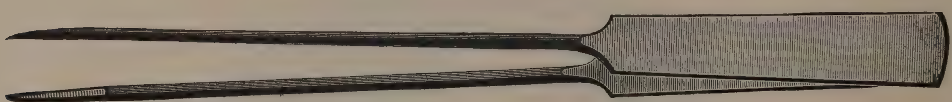


*Fig. 207.*

When the piece is adjusted in the heated furnace it should be allowed to remain for a few moments, and the lever controlling the rheostat then gradually and consecutively pushed from button to button, with an interval of from one to two minutes between each. When the last or highest step required is reached, the case should be closely watched until the body is properly fused, or timed from the fusing of the pure gold, when the lever should be immediately reversed, and the piece allowed to cool more or less slowly before removing.

Convenient pliers of special design, suitable for inserting or removing the support containing the piece, are illustrated in Fig. 207, but, while these are also very useful for solder work in general, because of their length, a special pair, kept perfectly clean, should be used for this work. In using pliers in the furnace, however, when the current is turned on care must be exercised to avoid bringing them in contact with the wires, and thus possibly fusing the latter or "burning out" the furnace by short-circuiting.

Fig. 208.

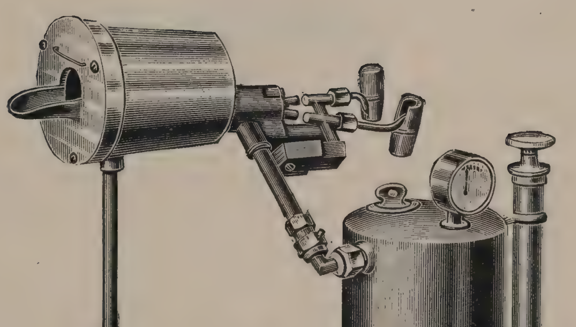


Fig. 209.

**Gasoline Furnaces.** Where it is not possible to secure commercial electric current, and for reasons of possible emergency and economy, the gasoline and gas furnaces, as now made, will serve the purpose nicely, and when properly used, will furnish adequate heat.

While it is true that such facilities do not afford the same degree of absolute purity of heat, there is but little danger of "gassing" or discoloring the porcelain, in their use, if the continuity of the muffle is perfect.

The gasoline furnace is preferable to gas because the heat production is aided by means of a pneumatic pump and the one manufactured by Dr. R. C. Brophy, of Chicago, Fig. 208, especially designed for crown

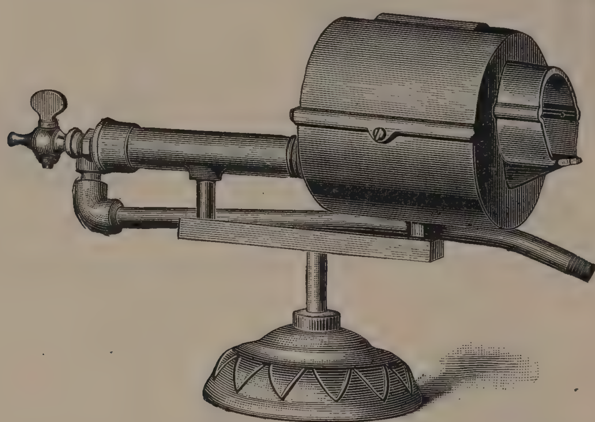


*Fig. 210.*

and bridgework, is adequate to the requirements in every respect. This furnace is made in two styles, one with a very thin fire-clay muffle, and the other with a nickel muffle, both of which are quite serviceable, with the preference perhaps slightly in favor of the former.

The Turner gasoline furnace, Fig. 209, manufactured by the Turner Brass Works, of Chicago, is similar in design (except that the nickel muffle is exclusively used), and is perhaps equally as effective.

In the use of these furnaces they should be started and well heated before the work is placed in the muffle, and the piece should first be thoroughly dried and heated at the opening before being carried into the inside.

As the muffle opens from one end the same precautions indicated in connection with similarly constructed electric furnaces should be ob-

served, and when the work is finally adjusted to place, the opening should be closed as a means of confining the heat to the inside and preserving its purity.

The fusing of the porcelain may be known either by watching with the eye, or by gold and time test, as previously described, in which the "plug" closing the opening of the muffle may be frequently removed for the purpose of observation, and the same requirements incident to turning off the heat, and allowing the work to cool slowly should also be observed.

If the required heat is to be obtained with facility, the supply of air must not be allowed to become diminished, hence the pump must be used with sufficient frequency to maintain high pressure.

It is also necessary to watch the condition of the muffle in order that it may be replaced when the continuity becomes destroyed by disintegration, by which means the possibility of "gassing" the work will be largely overcome; and, the greater facility with which this may be done, together with the inclosed shelf at the opening of the muffle, for heating the work, and the larger size of the latter, constitute the main advantages of the first-mentioned furnace.

**Gas Furnaces.**

The gas furnace designed by Dr. R. C. Brophy, Fig. 210, may also be successfully used. As a supply of air sufficient to afford complete combustion with illuminating gas is needed, however, the employment of compressed air, or the use of the "bellows" becomes necessary, and in the absence of the former, the effort required is of course much greater than that in the use of gasoline. Where compressed air is available, this furnace is to be especially recommended.

The more or less objectionable odor which emanates from the use of gasoline, however, is overcome, but the noise produced by the combustion in each is one of the most unfavorable features in connection with the use of either of these furnaces.

# Insertion of Gold Fillings in Artificial Teeth.

CHAPTER XIV.

Indications. Methods: Foil Gold, "Roman" Gold, In Combination with Backing: Procedure.

The insertion of gold fillings in porcelain facings employed in the construction of crowns and bridges is very often indicated as a means of simulating the remaining natural teeth, and thus observing, and complying with, the requirements of *harmony,* and with a view to and for the purpose of obtaining increased esthetic and artistic results, as has been previously mentioned.

**Indications.**

In the construction of individual crowns for any of the anterior teeth, if the remaining adjacent natural teeth are more or less freely filled with gold, the crown should almost invariably carry one, and sometimes two, small approximal fillings; and in bridgework involving the upper anterior teeth, where the lower anterior teeth are likewise filled, the insertion of one or two small fillings in appropriate locations will often aid materially in detracting from the artificial, and adding to the natural, appearance of the work.

Such fillings should never be inserted, however, with a view of making the work conspicuous, nor for the exclusive purpose of additional remuneration, and should be no larger than necessary to effect the *harmony* and *legitimate deception* which may be thus indicated by the adjacent natural teeth.

**Methods.**

The methods employed in accomplishing this work consist in preparing a retentive cavity and filling it with foil gold; in the use of liquid or "Roman" gold, which is painted over the desired area, and then *fired* in the furnace, in a manner similar to that employed in china decorating; and the construction of the filling as a part of the backing.

**Foil Gold.** In the employment of this method, which is perhaps the most generally used, and which affords the most permanent, expeditious and artistic results, a cavity, in the appropriate location and of the desired form, should be first outlined in the facing with a small fine carborundum-stone. (Fig. 211a.)

This outline facilitates the cutting or drilling of a cavity of the necessary retentive form and affords a definite marginal edge for the subsequent adaptation and finishing of the gold.

When so formed, adequate retention may then be secured by drilling a simple countersunk cavity of sufficient proportions in the center of the outlined area (Fig. 211b), or by cutting retentive grooves (Fig. 211c).

For the former purpose, which is more generally applicable to small cavities, an inexpensive diamond drill, to be used in the engine, is made by the S. S. White Dental Manufacturing Company (Fig. 212a), while the retaining grooves, which are best adapted to larger cavities, may be easily cut with a small copper disk coated with diamond dust, which is also prepared for this and similar purposes (Fig. 212b), or with the

a b c d

Fig. 211.

"cavity cutting" outfit manufactured by the same company, and which consists of a set of engine instruments of oval form, and graded sizes, and a cutting material composed of carborundum dust and glycerol.

While this latter method accomplishes the work nicely, it is scarcely so expeditious as the two former procedures, in the use of which the rapidity of their cutting properties is facilitated, and the danger of fracturing the facing is entirely eliminated, by the free use of oil or glycerine as a lubricant. This saves the instrument, and prevents the creation of heat otherwise induced by friction, which might cause fracture.

When the proper retention has been secured, the cavity should be thoroughly cleaned with soap and water and dried with alcohol and hot air, and then filled with small pellets of gold in the ordinary manner, and finished as usual (Fig. 211d).

While it is usually advisable to defer the insertion of such fillings until after the completion of the work, in order that any subsequent scratching or defacing of the surface may be prevented, it may frequently

become necessary, or seem desirable, to insert them before the construction of the work, or the assemblage of the parts.

This may be essential in bridgework constructed with gold to admit of placing the cavity in the desired location upon the approximal surface, and when here or otherwise indicated the procedure may be greatly facilitated by imbedding the facing in a base of modelling compound or sealing wax, as a means of holding it securely (Fig. 213).

In porcelain work, however, the procedure must necessarily be deferred until the piece has been finished, in order to preclude fusing the gold, and the same is likewise advisable in single crowns, for the reason mentioned, and in any event the preparation of cavity and insertion of filling should be done at the same time.

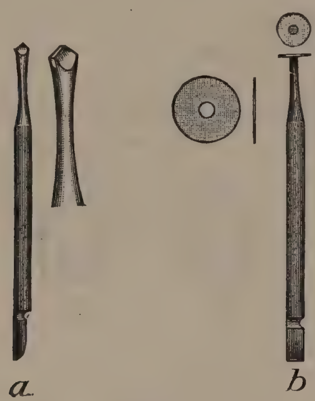


*Fig. 212.*

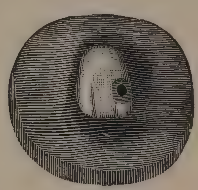


*Fig. 213.*

**Roman Gold.**

In the use of the so-called "Roman" gold, which is prepared for similar decorative purposes, and quite applicable to this, the cavity area should be first outlined, as indicated in Fig. 211a, and the gold then mixed into a paste of proper consistency and painted thickly over the surface, being careful to observe that it closely follows and evenly approximates the cavity margins.

The facing should now be placed near a flame, or close to the previously heated furnace, and allowed to remain until the gold has become *thoroughly dry*, when it should be placed in the furnace and "fired" until the gold fuses, which may be readily observed by its *vitreous* appearance.

After allowing to cool more or less slowly, the filling may be easily finished and polished with burnishers, or *fine* cuttle-fish disks, and the buff wheel.

In gold work such fillings should be made *before* the final attachment of the facing to the metal parts, with solder, while in porcelain work the lower heat required to fuse the gold demands that they be made after the completion of the piece.

While this method affords artistic results, the objections to it lie in the fact that such fillings are likely to be less permanent, because of a tendency to flake and chip.

**In Combination with Backing.**

A method involving a less simple detail, and requiring more time, perhaps, but productive of very artistic results, is applicable to gold work, and consists of making the filling in combination with and as a part of the backing.

Its employment is indicated more especially, however, in simulating approximal fillings involving the incisal angle, which is sometimes desirable, and which would be more or less difficult by the other methods,

a b c d e

Fig. 214.

because of the limited opportunity afforded by the ordinary facing for securing adequate anchorage for such fillings.

**Procedure.**

When such a filling is indicated, or where it may be desirable to employ this method, the facing should be first ground to the proper and required adaptation, and then prepared for the reception of the backing, in the usual manner.

That portion of the porcelain which involves the location and area of the desired cavity formation and gold restoration should then be ground away on a *slight bevel toward the lingual side,* until a perfectly smooth marginal outline has been secured (Fig. 214a).

A backing of about 34 gauge pure gold should now be adapted to the facing, and burnished up well against the cavity margin, allowing a surplus of about 1/32 of an inch to project beyond the latter, and upon the incisal end (Fig. 214b). When this has been accomplished, a piece of 22 karat gold plate, 29 or 30 gauge, should be adapted to this, extending from the pins to the incisal end, and projecting out to the original

outline of that portion of the facing which has been destroyed (Fig. 214c).

This forms a matrix, indicating the desired formation of the filling, and the two backings should now be removed and united with solder in the manner previously described in connection with "re-enforced backings." Their detachment from the facing without danger of changing the shape of the thinner one is made possible and facilitated by the slight lingual bevel given to the cavity wall in its preparation.

When their union has been effected, the matrix formed by the two backings should be filled with 22 or 20 karat solder until the desired contour obtains (Fig. 214d).

This should then be adjusted to the facing, securely attached by bending the pins, and finished with files, stones and disks until the adaptation of the backing and the contour of the filling are as desired (Fig. 214e), when the piece may be completed and finished in the usual manner.

In securing the desired contour of the filling with solder, a high karat must, of course, be used, because of the susceptibility to discoloration, and clean flux must be applied to avoid a pitted surface.

In flowing the solder, it is also well to observe the precaution of fitting a piece of gold or platinum wire or plate into the matrix before the procedure, as this insures a preservation of the adaptation of the pure gold to the cavity margin, which otherwise might be somewhat changed by shrinkage, if solder alone be used.

# Finishing, Polishing and Mounting.

CHAPTER XV.

Finishing. Polishing: Facilitating Procedure. Precautions. Gold Plating. Cyanide Solutions, Prepared Solutions. Mounting: Preliminary Adjustment; Temporary Mounting; Permanent Mounting; Use of Cement; Procedure; Dowel Crowns, Shell or Telescope Crowns, Insuring Accuracy of Adaptation to Root, Two or More Crowns, Therapeutics. Use of Gutta Percha; Advantages, Disadvantages, Procedure; Dowel Crowns, Shell or Telescope Crowns, Final Mounting. Combining Cement and Gutta Percha; Procedure. Variations of Procedure; Use of Chloropercha; Use of Shellac and Sandarac; Rubber Tissue. Final Precautions. Removing Crowns Mounted with Gutta Percha.

The finishing, polishing and mounting of crowns, while almost equally as important as any other special portions of the work, are, nevertheless, quite often neglected or done in a more or less perfunctory manner, because of not being fully appreciated.

This should not be so in any single instance, for the reason that proper *finishing* and *polishing* adds materially, not only to the artistic appearance, but also, and particularly where gold is used, to the increased hygienic condition presented in the finished piece; and successful *mounting* has much to do with the degree of comfort and permanency of the operation.

## Finishing.

When the case has been removed from the investment, it should first be treated to the acid bath for a sufficient length of time to insure the thorough removal of all products of oxidation, and of all particles of investment material and "flux." After this has been effectually accomplished, the acid should be thoroughly removed by washing freely with clean water, and the case then finished in accordance with the requirements, and with the maximum of artistic possibilities to which gold and platinum are so highly susceptible, as is evidenced in the jeweler's art, and in jeweler's products.

The primary efforts in finishing should consist in obtaining the required contour; the desired obliteration of all joints, and evenness and

smoothness of the surfaces; and should include removing, or diminishing any undesirable or unnecessary display of metal upon any surface. Owing to the small size of the piece, this may usually be best accomplished with small carborundum stones, of coarse and medium grit, used in the engine. These should be followed with emery or sandpaper disks of medium grit, and subsequently with very fine, or cuttlefish, disks, until every scratch is removed, and the surfaces are perfectly smooth.

A more finished and artistic appearance may be given to the lingual surfaces of anterior crowns with gold backings by making an effort to reproduce the natural shape and form of this surface in the gold (Fig.

*Fig. 215.*

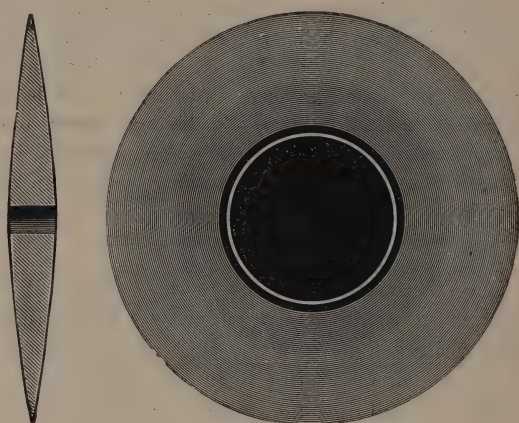


*Fig. 216.*

215), which may be easily and quickly done with a knife-edge carborundum stone, and plug-finishing burs.

## Polishing.

This should then be followed by highly polishing the metal with felt and brush wheels on the lathe. The primary polishing should be obtained with a thin-edge felt wheel (Fig. 216) and moistened pumice stone of medium grit; and the wheel should be previously soaked in water, so that it will absorb and carry the pumice stone with it during the procedure.

When the desired smoothness of surface has been thus obtained, the final polishing should be given first with a stiff brush-wheel (Fig. 217a), used with the pumice stone, and then with moistened whiting, or precipitated French chalk; and this should be followed with a *soft* brush-


Fig. 217.

wheel (Fig. 217b) and whiting, and finally with a cotton "buff" wheel (Fig. 217c) until a highly polished and mirror-like surface presents.

Such a finish requires but little effort and but a few moments' time and is always indicated because of the more artistic appearance of the work, and of its being thus rendered more hygienic. The more highly the surfaces of metal are polished, the less susceptible are they to discoloration, and the more permanent and self-cleansing is the finish, because less opportunity is thus afforded for the subsequent attachment of accumulations in the mouth.

Jewelers' rouge and various other polishing compounds are often advocated and are employed with the "buff" wheel for the final polishing, but nothing seems to produce better results than whiting, if properly

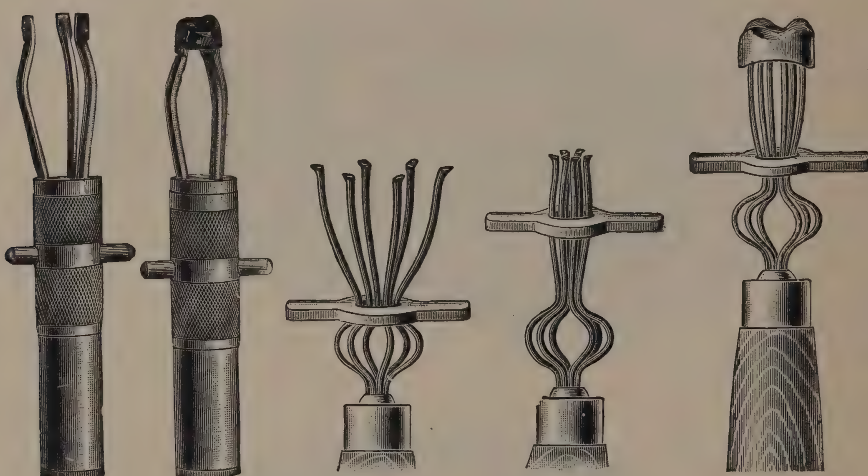


Fig. 218. Fig. 219.

used, as indicated; and the reddish color imparted by rouge to the metal, together with the discoloration of the fingers incident to its use, are more or less objectionable.

**Facilitating Procedure.** As single crowns, and particularly those of the "shell or telescope" variety, are somewhat difficult to handle while polishing, various styles of "crown-holders" have been devised for facilitating this part of the work.

The most ingenious and perhaps universally useful of these instruments is the one known as Fahey's Ideal Crown Holder, manufactured by the Dental Specialties Company, of Chicago (Fig. 218). This is adaptable to almost any size of crown, because of one blade being removable;

and, the spring being adjustable, it holds the crown securely with little or no danger of distorting its shape.

A similar device which is also useful for this purpose is known as the "Burgess" crown holders, and is shown in Fig. 219.

The filling of the crown with compounds of sealing wax, and then inserting a piece of wood into it while it is hot, is sometimes recommended, but is objectionable because of the difficulty of removing the compound after the polishing is completed; and the fitting of the end of a piece of wood of suitable length to the interior of the crown is likewise a poor method, because of the possible distortion of the shape of the band in so doing.

While dowel crowns are not quite so difficult to handle in the polishing, the use of one of the pin vises previously recommended may sometimes be found convenient.

**Precautions.** Although it is scarcely possible to give too high a polish to the exposed surfaces of metal which are to be permanently fixed in the mouth, it is, however, quite possible, and indeed sometimes quite easy, to polish through the thinner portions of a crown in the use of disks and felt wheels; hence, in polishing, extreme care should be exercised to prevent such a mishap, as well as to preclude any unnecessary thinning of such parts.

## Gold Plating.

An increased artistic effect, and a more permanent finish, may be obtained by subjecting the piece to the electroplating process, *after it has been highly* polished. This imparts a uniform rich yellow color to all metal surfaces and affords a surface of pure gold which is more or less permanent, and which is not so easily attacked and discolored by the chemical action of the secretions.

**Cyanide Solution.** Solutions for this purpose may be made by dissolving fifteen grains of the chloride of gold in a porcelain or glass vessel containing about four ounces of distilled water, and then adding to this a like quantity of water into which about thirty or forty grains of pulverized potassium cyanide has also been previously dissolved in a similar vessel. This is known as the "*cyanide solution,*" the approximate formula for which, as generally employed, is as follows:

| | |
|---|---|
| Chloride of gold | gr. xv. |
| Cyanide of potassium | gr. xxx. to xl. |
| Distilled water | oz. viii. |

A small ordinary "primary" or "dry cell" battery may be used, and the work to be plated should be attached to the *negative* pole and then

suspended in the solution, with a piece of thin pure gold plate likewise suspended from the *positive* pole, *avoiding contact* between the two.

If the piece is *well finished* and *highly polished*, and then washed with bicarbonate of sodium to remove all traces of organic matter, and then fastened to the pole by so coiling the wire as to have a well-distributed contact over the surface of the metal to be plated, a few minutes' immersion in the solution will afford the desired result, after which it should be again highly polished with the *"buff"* wheel.

**Prepared Solutions.** Solutions which may be used without a battery are prepared for this purpose, and while they seem to afford good results, the deposit of gold is probably not so heavy, and hence not so permanent, and the solution can only be used until it becomes inactive.

In their use a sufficient quanity of the solution should be placed in a porcelain or glass vessel and heated until *warm*, and the work then attached to a strip of *pure zinc* and immersed therein.

Moderate heat and slight agitation will effect the desired result in a few moments, and the permanency and effectiveness of the solution may be increased by suspending a small piece of pure gold plate on another zinc strip hooked over the edge of the vessel so that the gold is immersed.

## Mounting

No portion of the entire procedure incident to the construction and application of the work is of more importance than the detail involved in its secure and permanent attachment to the root.

In order that such a fixation may be secured with reasonable facility, the medium used must possess sufficient plasticity to admit of the proper and accurate adjustment of the crown, and to completely fill the intervening space between it and the root, and must then afford a substantial and more or less insoluble and impervious union between the two.

**Preliminary Adjustment.** Previous to any effort toward permanent mounting, the crown should *always* be adjusted to position on the root, as a means of ascertaining with absolute certainty that it meets with all the requirements of fit, occlusion, etc., as well as to admit of making any changes in its form or shape which may be necessary, and of subsequently repolishing, which can never be done so well after permanent fixation is secured.

The adjustment may be greatly facilitated in so far as discomfiture to the patient is concerned by slightly moistening the interior of the band with 95 per cent carbolic acid, or by *carefully* bathing the gum surrounding the root with a two or a four per cent solution of cocaine just previous to inserting the crown.

The former procedure is perhaps the more simple, equally effective and less dangerous one, and usually affords sufficient anesthesia of the parts to admit of the subsequent permanent mounting without any appreciable discomfiture; and any possible injury to the tissues from the escharotic effect may be overcome by bathing them with alcohol as soon as the crown is forced to place.

The driving of the crown to position is never warrantable or necessary if the adaptation is anywhere near correct; anterior crowns can usually be forced to place with the fingers, and a firm closure of the jaw will aid in adjusting those on the posterior teeth. In the event of the absence of occluding teeth, a small flat piece of wood may be used to advantage here, as indicated in the fitting of bands.

When it has been observed that the adaptation is correct, the crown should be then removed and mounted, as the patient should never be dismissed, *no matter how firm it may remain in place at first,* without the presence of some medium of attachment which may preclude its becoming loosened, and any possible distortion of the fit or shape which might result therefrom in wearing, not overlooking the danger of swallowing it.

## Temporary Mounting.

In the event of permanent mounting being contraindicated for a time, the crown may be temporarily mounted in a manner which will admit of its being worn without danger of becoming loosened or distorted in shape, and of its being removed with facility whenever necessary.

When such a procedure may for any reason be indicated, *temporary stopping* will serve as a sufficiently substantial medium to afford attachment from sitting to sitting, or for a few days' duration, but it does not possess sufficient integrity to be reliable for any great length of time.

In its use, the root should be dried with alcohol and hot air, and a sufficient quantity *thoroughly heated* and placed inside of the band, and the crown then quickly forced to place, after which it may be chilled with a spray of cold water directed upon the crown, and the surplus then trimmed away.

Crowns so mounted may be easily removed with a pointed instrument, hooked over the edge of the band, as heat higher than the temperature of the body is scarcely ever necessary to destroy or reduce the adhesive property of this material, which accounts for its not being reliable for more permanent usage.

## Permanent Mounting.

The requirements of a permanent mounting are best obtained at the present time in the use of the oxyphosphate of zinc cements and gutta

percha. Amalgam was formerly used to some extent but has been practically abandoned in view of the greater facility with which either of these may be successfully employed, and the absence of adhesive properties.

## Use of Cement.

Cement is perhaps the more generally employed because of the facility with which it may be manipulated, combined with its adhesive properties and inherent strength when moisture is excluded.

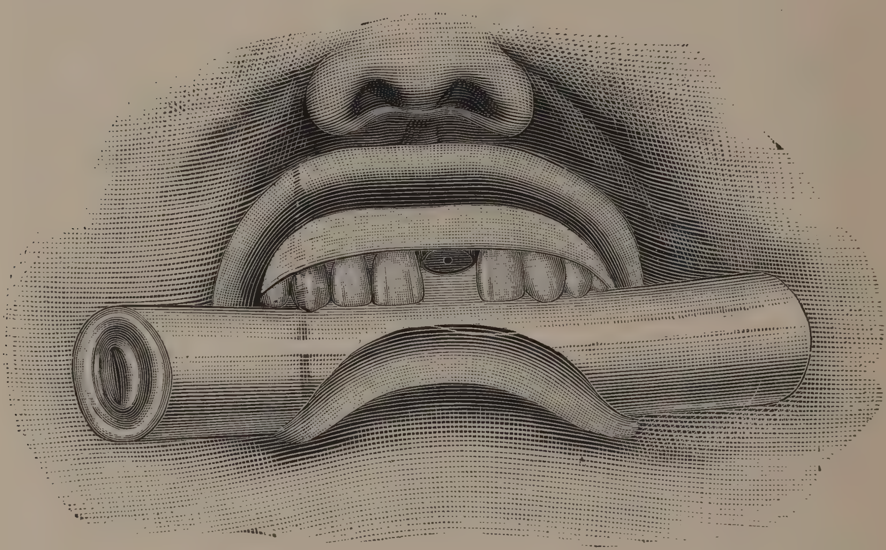


*Fig. 220.*

The disadvantages incident to its use are the temporary irritation to the tissues in mounting; the possible more or less permanent irritation which may be induced by hidden particles accidentally left in contact with the gum after mounting; its susceptibility to dissolution when exposed to the action of the secretions; its possible shrinkage in crystallizing, and the extreme difficulty with which a crown may be removed, and particularly a dowel crown, when occasion demands.

**Procedure.** When it has been ascertained that the adaptation is correct, and when the crown is ready to be permanently mounted, its inner surface should be cleansed with alcohol, and thoroughly dried with hot air.

The root should now be *rendered aseptic* by a careful bathing with carbolic acid, or by the use of pyrozone or hydrogen peroxide, or any good antiseptic, and then thoroughly dried with pledgets of cotton.

Thorough drying is *absolutely essential* and may be facilitated by precluding contact of the lips, cheeks, or tongue, with cotton rolls or pads, and then using alcohol or chloroform evaporated with compressed air, or warm air from the chip blower. The non-absorbent cotton rolls prepared

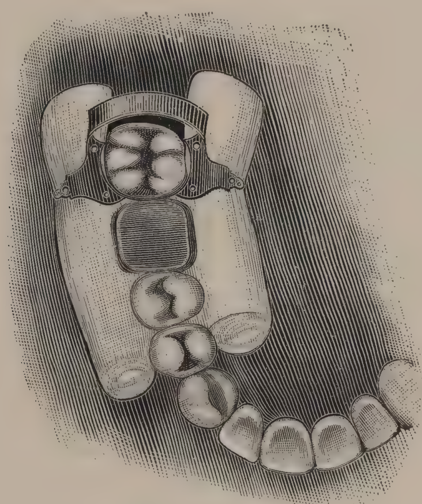


*Fig. 221.*

in various sizes and lengths by Johnson and Johnson are very convenient for such purposes. The use of these in the anterior part of the mouth is illustrated in Fig. 220, and if the root is in the posterior part of the mouth, a "mouth prop" adjusted in the opposite side to hold the mouth open will often be found very useful, and the cotton rolls may be effectively retained with a clamp adjusted to an adjacent tooth. Fig. 221.

A good reliable medium setting cement should now be mixed to a creamy consistency, which should, and can best, be done by an assistant, when possible, in order that the operator may confine himself to observing that the root does not become moistened.

**Dowel Crowns.** If the crown possesses a dowel, the canal, or canals, should first be thoroughly filled with the cement. This may be accomplished by using a root canal plugger and a pumping action, until the cement has been carried to the extreme ends. A cement syringe for this purpose has been devised by Dr. H. L. Cruttenden, but its use usually involves more time than is necessary or warrantable for such a simple procedure.

When the canal has been thus well filled, the dowel and interior of the cap should be coated or covered with a layer of cement, which, if done by the assistant during the filling of the canal, will greatly expedite the operation, and the crown should then be quickly and firmly pressed to its proper position on the root.

After becoming assured of its having assumed the proper relation, the patient may be requested to close the mouth until the cement has at least partially crystallized, the length of time required for which will be indicated by the surplus remaining upon the mixing slab. It is desirable that the first stages of the setting of the cement should be obtained under pressure. Therefore the operator should press firmly upon the crown with the finger or a piece of soft wood for at least five minutes.

The crystallization may be hastened somewhat by directing warm air from the chip blower upon the crown, and when sufficiently hard, all surplus should be carefully removed with pledgets of cotton, and a sharp-pointed explorer passed carefully around the band beneath the gum.

A ligature drawn through the interproximal space may further insure the removal of any remaining surplus at these points, which precautions are always advisable, because of the extreme irritation to the gum which is produced by such hidden particles after their complete crystallization.

Coating the outside of the band along the cervix with vaseline or oil just previous to mounting is recommended as a means of facilitating the removal of the excess by preventing its adhering to the edge or surface of the crown.

**"Shell or Telescope" Crowns.** In mounting the "shell or telescope" crown, the same detail is indicated, but as a larger quantity of cement must be placed in the crown, care should be exercised to have it cover all surfaces, and be devoid of air spaces, in order to insure the complete filling of the entire intervening space between it and the root. The proper quantity is governed, of course, by the length of the root which projects or extends into the crown.

As soon as the crown is forced to place, the mouth should be immediately closed and the occlusion observed, and when this is as it should be, which will be indicated by the normal contact of the adjacent oppos-

ing natural teeth, a roll of cotton should be placed between the crown and the opposing teeth, and a steady and firm pressure of the jaw in normal occlusion maintained until the cement has crystallized, in order to prevent any possible displacement.

The same precautions incident to the removal of all excess cement should then be observed with equal care, and before dismissing the patient it should be carefully and finally noted that the crown *does not occlude too hard,* as subsequent discomfiture will invariably result if this condition exists.

**Insuring Accuracy of Adaptation to Root.**

If any doubt exists as to the accuracy of the relation of the cervical edge of the crown to the periphery of the root, some means of insuring a close joint between them should be observed.

This may often be aided materially by slightly reducing the circumference of the edge of the band with curved or small, pointed pliers, just

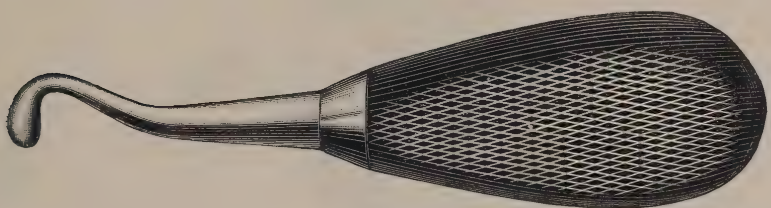


*Fig. 222.*

previous to the final mounting, as it may have become somewhat enlarged, by stretching, in the fitting and preliminary trials.

The use of a smooth foot plugger adjusted to the automatic mallet may also be found useful, and particularly along the buccal edge, after the crown has been mounted; and the approximal edges may be brought into closer contact by inserting a small amalgam burnisher into the interproximal spaces, and exerting some little effort in this direction. Either a suitable burnisher, such as is illustrated in Fig. 222, or the foot-plugger, may often be employed to good advantage upon the lingual surface, but in the use of either, some little care should be observed to avoid producing sharp angles at the corners, and yet to secure a close adaptation and particularly at the bifurcation of the roots.

In extreme cases of ill adaptation or of exceedingly constricted necks, a good result may often be obtained by encircling the crown with a piece of German silver, or copper wire, from 24 to 26 gauge, passed through the interproximal spaces, and the ends then twisted from the

buccal side (Fig. 223), until the loop breaks. This affords a uniform compression of the edge of the band by condensing the molecules, but in effecting it, it should be observed that the wire does not slip beneath the edge of the band, which tendency may be overcome by slightly *flattening* that portior which rests against the *lingual* surface of the crown, or which forms the center of the loop. While ordinary silver suture wire, or that made from other alloys or metals may be used, those recommended give the besι results because of their tensile strength.

Wherever possible, all of these procedures should be observed, or executed, after the crown has been properly mounted, and a firm closure of the jaw should be maintained, in order to prevent lifting it from its

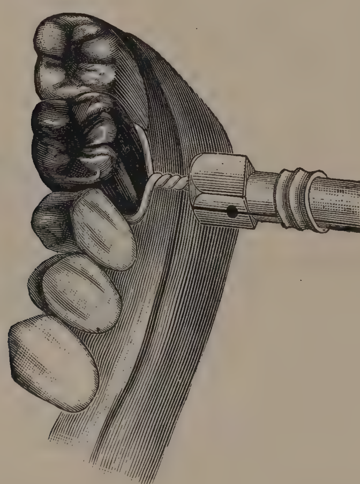


*Fig. 223.*

proper relation. The cement should first be allowed to become partially crystallized, also, in order that any slight hemorrhage produced may interfere as little as possible with its perfect crystallization.

An instrument designed for compressing the edge of the band after mounting has been devised by Dr. Rudolph Beck, of Chicago (Fig. 224), and may sometimes be found more or less useful for this purpose.

**Two or more Crowns.** When two or more crowns are to be inserted at the same sitting, *each should be mounted separately,* as the crystallization of the cement seldom affords opportunity for the thorough and accurate mounting of more than one

with each mixing; and the operator should never be hurried, nor make any effort to expedite matters to too great an extent in this procedure.

**Therapeutics.** In cases of extreme pain after mounting, which is sometimes induced by the irritating influence of the cement upon inflamed or hypersensitive tissues, but which is usually only temporary, relief may be afforded by painting the gums around the neck of the crown with a two or a four per cent solution of cocaine; or with the tincture of iodine, or the usual remedies for counter-irritation. A spray of hot water is also sometimes very effective, and where an astringent may be indicated, in cases of congestion, zinc sulphate or a saturated solution of tannic acid in glycerine may be employed.

## Use of Gutta Percha.

The difficulty encountered in the removal of crowns mounted with cement, and particularly of dowel crowns, has created a demand for some

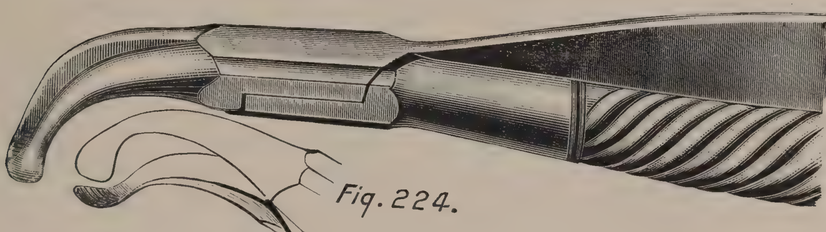


Fig. 224.

medium which would afford a secure and reliable attachment, and which would at the same time admit of subsequent removal in the event of necessity, without requiring the destruction of the crown or of any appreciable amount of tooth structure.

**Advantages.** The ordinary *red or pink base-plate gutta percha,* skilfully manipulated, seems to meet such requirements in admitting of easy removal, as well as to possess the additional desirable qualities of offering sufficient integrity in the attachment, and of being insoluble, non-irritating, and more or less impervious.

Its use also affords a somewhat cushion-like seat for the crown, which is an advantage because of relieving the "deadened blow" in the stress of mastication, and of thus reducing the shock, and diminishing the tendency of porcelain to fracture, as compared with a more non-yielding medium.

**Disadvantages.** The disadvantages incident to the employment of this material lie mainly in the skill and time required to successfully manipulate so refractory or intractable a substance; and yet its integrity as a substantial mounting is due to such properties, and will, of course, increase in proportion thereto, so long as it is capable of being rendered sufficiently plastic to be properly moulded, in the adjustment of the crown.

While its employment is probably more especially indicated for dowel crowns, this same essential property may here prove a disadvantage, if any great surplus is present, by offering sufficient resistance to expand the band, and thus destroy the accuracy of its adaptation.

This objection may be overcome, however, by careful manipulation in obtaining the maximum of plasticity, and avoiding the presence of any unnecessary surplus. Successful results will depend upon a willingness to consume time, and to observe the detail with deliberate painstaking care, as well as in the acquirement of the necessary degree of skill; and will increase in proportion thereto.

**Procedure.** In its manipulation, the material should be cut into narrow shreds or strips, from one-half to one inch in length, and these should then be slowly and carefully heated until plastic. The heating should be done at the chair, and may be best accomplished by placing them on a porcelain-lined electric gold annealer, such as is manufactured by Mr. M. M. Kerr, of Detroit, Mich.; or upon a mica slab placed over a flame, where they should remain until the mounting is completed. The Custer electric gold annealer has an accompanying porcelain slab which may also be used for this purpose.

Direct contact with the flame should always be avoided, as this destroys the working properties of the material by rendering it harsh and tough.

**Dowel Crowns.** While the gutta percha is being thus heated, the dowel of the crown should be spurred with a sharp knife-blade, and it and the interior of the cap then slightly moistened with a solvent of gutta percha, to facilitate a secure attachment. Oil of cajeput is probably the best solvent for this purpose, though oil of eucalyptol or chloroform may be used.

When thus prepared, a piece of the gutta percha should be picked up with foil carriers, coiled around the dowel from its apex downward, Fig. 225A, and then packed down closely with the fingers. If one piece does not appear to be sufficient for the first trial, another may be added, until what seems to be adequate is obtained, but a surplus should be avoided.

The crown should now be placed upon the heater, and the canal and end of the root then moistened with a spray of water from a syringe, in order to prevent the gutta percha from adhering, after which the heated crown may be grasped with a napkin and forced to position. If no great surplus has been used, it will go readily to place without driving, when it should be at once removed, and small pieces of the heated material added, where needed; it is then placed again upon the heater, the root moistened, and this procedure continued until the gutta percha is moulded to fill the space between crown and root, when the correct relation exists.

All surplus should now be trimmed off even with the edge of the band, and the crown then replaced upon the heater.

In the event of the presence of too much gutta percha to admit of the proper adjustment, the surplus should be trimmed away with a hot instrument, and the crown reheated and carried to place, until the proper relation maintains.

**Shell or Telescope Crowns.**

The procedure indicated in the mounting of the "shell or telescope" crown is the same, except that the gutta percha may be cut into small square pieces, of convenient size; and these should be placed in the bottom of the crown and around the joint between cusp and band, until they may be gradually moulded to fill the space.

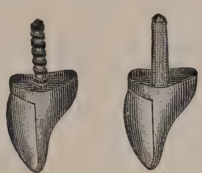



*Fig. 225.*

**Final Mounting.**

Up to this point, the root should be moistened previous to each application or trial of either style of crown, in order that its removal may be made easy by preventing adhesion.

When ready for the final mounting, the crown should be again placed upon the heater, and allowed to remain until the root has been rendered aseptic, and then thoroughly dried in the manner indicated in connection with cement. It should now be moistened with the oil of cajeput, or with a thin solution of chloropercha, and the crown then picked up with the napkin, and forced to place, where it should be held firmly for a few moments, until the gutta percha loses its heat, which may be hastened by a spray of cold water.

## Combining Cement and Gutta Percha.

While either cement or gutta percha may be used in mounting shell or telescope crowns, on the posterior teeth, the advantages of both may be obtained for dowel crowns by combining them. This may be done in such manner as to admit of the subsequent removal of the dowel, in case of accident or necessity without any great difficulty, and to overcome any possible danger of enlarging the narrow band, such as may possibly result from the use of gutta percha alone.

Whatever advantages cement may possess as a mounting medium, it is seldom the best practice to *surround the dowel* exclusively with this material, because of the extreme difficulty of ever removing it from the root. Hence, if one is not sufficiently skilled in the manipulation of gutta percha alone, some means of facilitating the removal of such crowns, without injury to the root, is always indicated.

**Procedure.** This may be accomplished by using sufficient gutta percha, in the manner described, to surround the dowel only (Fig. 225B) and then completing the mounting by filling the cap and coating the walls of the canal with cement, thus obtaining, in a measure, the advantages of both, with the minimum of the objections of each.

Various combination cements in which gutta percha filings, or gutta percha in solution, is incorporated with the oxy-phosphate of zinc, are advocated, but as their use is at present somewhat experimental they are not recommended.

## Variations of Procedure.

The skill required to successfully manipulate gutta percha has caused the adoption of several variations of procedure, each with a view of accomplishing the desired result with greater facility and expediency.

**Use of Chloropercha.** A thick solution of gutta percha in chloroform is sometimes employed for the entire mounting of dowel crowns, but is not recommended, because of the shrinkage of such medium, due to the evaporation of the chloroform. This shrinkage will, of course, afford some opportunity for the subsequent loosening of the crown, and thus diminshes the stability and permanency of the attachment.

It may be used around the dowel and on the inner surface of the cap, however, in place of the base-plate gutta percha, and when so employed, the chloroform should first be evaporated by passing over a flame, and the crown then mounted with cement, as indicated. This prevents the adhesion of the cement to the surfaces of the dowel and cap, which, of

course, facilitates the removal of the crown, but not to the extent afforded by the use of the gutta percha alone, when it entirely fills the canal.

**Use of Shellac or Sandarac.**

A heavy coating of very thick shellac or sandarac varnish over the dowel, and on the inside of the cap will also prevent the adhesion of the cement to the metal, and thus facilitate the removal of the crown, and particularly of the dowel; and while it is better to use either one of these alcoholic solutions than nothing at all, their similar employment only affords the same advantages and limitations mentioned in connection with the use of chloropercha.

**Rubber Tissue.**

A preparation of rubber in the form of very thin tissue, which is quite adhesive, is recommended for similar use by Dr. W. F. Lawrenz, of St. Louis, but at the present stage of its experimental application, it seems to offer no particular advantages over the preceding materials, and is more difficult to manipulate.

## Final Precautions.

When the mounting has been completed with apparent satisfaction, the patient should never be dismissed until it has been carefully ascertained that the crown is firm, and that the occlusion and all surrounding conditions are favorable; and a further precaution against any possible subsequent displacement, annoyance or discomfiture should be observed by requiring the patient to return in the course of a few days for final inspection.

## Removing Crowns Mounted with Gutta Percha.

The removal of crowns mounted with gutta percha may be easily effected by applying sufficient heat to the exposed portion of the crown to soften the material. This may be done by heating the beaks of a pair of heavy pliers of good size, placing them on the crown, and sustaining the contact until the heat is conveyed throughout its length, which will usually be noted by a response from the patient, when the gutta percha surrounding it will be sufficiently softened to lose some of its adhesive properties, and admit of the ready detachment of the crown with a hooked or pointed instrument.

In this procedure, care should be exercised to guard the face and lips of the patient, as well as to protect the porcelain, which may be aided by cotton rolls or pads; and the pliers should be heated in the laboratory, or where the heating may not be observed by the patient, and then carried to the chair wrapped in a napkin or towel, with only the beaks ex-

posed, as a matter of convenience to the operator, and of protection and relief from fear to the patient.

A more convenient method which may sometimes be employed with success has been suggested by Dr. C. B. Rohland. This consists in placing a leather or moose-hide polishing wheel in the engine and revolving it with rapidity against the crown until the friction will thus produce sufficient heat to admit of its removal.

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